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november, 1948

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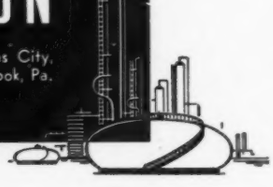

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THIS MONTH'S COVER—Roustabouts on Shell Oil Company's new super drilling rig operating in the swamplands of Louisiana center the bit over the breaker plate in the rotary table. The 1,000-ton barge-mounted rig is moved from location to location by a tug. The 225-foot derrick is designed to drill to 18,000 feet and has a working capacity of 950,000 pounds. Courtesy Shell Photo Library.

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EDITORIAL

NATIONAL SECURITY AND THE OIL INDUSTRY

DUE perhaps to the manner in which it first came to public attention, the staff report on the subject of petroleum prepared for the National Security Resources Board has been somewhat widely misunderstood. Though it is the result of extended study, it is a preliminary survey which as yet has no official standing since it has not received the approval of the Board itself. In fact it is only because a few copies were supplied to certain officials and to a few members of the oil industry, who are charged with consideration of the subject with which it deals, that even fragmentary knowledge of its content was revealed. It was submitted to these men for the purpose of giving to the Board the benefit of comment and criticism which conceivably might lead to changes before it is passed along to the Chief Executive as part of the general survey of national resources which the Board is making.

Yet this report, together with others that are being independently prepared, is of deep significance to the nation as a whole and to the oil industry in particular. It recognized the fundamental importance of oil as a chief factor of national defense in any emergency that may arise up to and including war, should that dire situation be forced upon us. It further reflects the determination of the military authorities and other responsible officials to obtain definite assurance that adequate supplies shall be available, should any sudden demand arise for greatly increased quantities of petroleum.

This subject has been under more or less constant discussion since the close of World War II. Various proposals have been put forward such as the importation of crude to be stored in protected areas above or below ground, the development of production from government-owned lands to be set aside solely as an emergency reserve, or the construction at government expense of a series of plants for the manufacture of synthetic products. All of these projects were open to serious practical objections with the result that no specific course of procedure has been adopted. Now, however, with international tension steadily rising, it is inevitable that greater insistence will be placed upon definite assurance that reserve supplies will be at hand if and when they are needed and that a continuing policy of national preparedness in the matter of petroleum shall be established.

It is a virtual certainty that bills, probably a number of them, having this objective in view will be brought before the Congress at its next session and that there will be a strong though possibly ill-informed public demand for action. It, therefore, behooves the oil industry to formulate its own views as to effective means of meeting this situation and to be prepared to offer a positive program rather than mere negative opposition to proposals that may be unsound or perhaps damaging.

There are to be sure divergent schools of opinion on this whole subject. There are those who scoff at the suggestion that the United States will need to depend upon oil from outside its own borders, at least within any time that concerns the present generation. They have bitterly fought the importation of oil and opposed reductions in the tariff on such imports. They insist that any lag in discoveries during or since the war is to be attributed to inability to obtain sufficient equipment and to lack of incentive because of the imposition of uneconomic price levels. Given sufficient materials and prices that justify the risks of exploration, they say, and the industry itself will find oil sufficient to supply current needs and to afford a reserve of potential production adequate for emergncy requirements. In this connection it is noteworthy that the staff report to NSRB recommends price encouragement to domestic exploration and development.

Others, sharing confidence in the future discovery of oil in quantities as great or greater than have been located heretofore, feel that it would be sound policy to spread the utilization of these resources over a longer period by permitting larger imports, particularly of certain grades, and by encouraging a gradual shift to natural gas or gas from coal for space heating, reserving petroleum for uses that are considered more efficient and more remunerative. They hold that the oil industry should direct its efforts more largely to the provision of products that will better serve consumers and will add greater strength to national security.

On one point sentiment within the oil industry is definitely united. That is in opposition to the placing of its operations under bureaucratic government control. Admitting the inevitability of national regulation over the supply and distribution of products in the event of war, the long record of successful progress which the industry has to its credit and the stifling of individual initiative inseparable from governmental dictation, as exemplified in other less exacting industries, provide a convincing case for the preservation of private enterprise in this all-important field. To maintain the freedom of action which has made the industry great and helped to keep the nation safe, it is of paramount importance that its members should sink minor differences and work out a program for the future that will command confidence and prevent the enactment of destructive legislation.

Charles F. Kettering

CHARLES F. KETTERING AWARDED DISTINGUISHED ACHIEVEMENT MEDAL

FOR the second time in three years the American Petroleum Institute gold medal for Distinguished Achievement goes this year to a representative of the automotive industry. Charles F. Kettering of General Motors, inventor and outstanding proponent of research as a tool for advancement of industry and the general well-being of mankind, is the recipient.

First award of the medal two years ago was to Henry Ford, father of the low-priced, mass-produced car for the average man. Dr. William Burton, originator of the cracking process which enabled the petroleum industry to supply enough cheap motor fuel to power the world's great fleet of motor vehicles and airplanes was awarded the medal at the 1947 meeting.

This year the award honors the man who sponsored the research whcih lead to the discovery of tetraethyl lead as a knock suppressor and hence made possible the high compression engine which, in turn, has contributed to the conservation of the world's supply of petroleum hydrocarbons by increasing car mileage per gallon of motor fuel and giving greater performance.

Mr. Kettering's first contribution to the automotive-petroleum industries was his improvement in 1909 of the battery ignition system then used on most cars. He lengthened the driving range of a car from about 300 to more than 2,000 miles on a single set of dry cells. This was followed quickly by the invention of the generator for electric lighting of the car and conversion of the generator into a motor for the self starter. The complete starting, lighting and ignition system was ready within a year from the time Mr. Kettering started work on the problem. Effect of the development of the electric system was greatly to popularize motoring. Automobile production increased from 199,300 in 1911 to 356,000 in 1912 and continued rapidly upward to more than a million and a half in 1916.

In 1920 Mr. Kettering's Dayton laboratories were taken over by General Motors, and he became head of research for that company. During his management tethaethyl lead was developed.

One of the outstanding contributions to transportation made by Mr. Kettering's research laboratories is the two-cycle diesel engine, used in streamlined trains, diesel locomotives, marine installations and stationary power plants. This development, which was started in 1929, has completely revolutionized railroad equipment and operation. From a high of over 200 pounds per horsepower, the weight of the engine has been reduced to only 16 pounds per horsepower. Fuel consumption and operating costs are likewise lower, and speeds have increased to over 120 miles per hour.

Shortly before his retirement as an active vice president of General Motors and general manager of the General Motors Research Laboratories in June 1947, Mr. Kettering, in a paper read before the Society of Automotive Engineers, proposed a long-range program of cooperative research and engineering between the petroleum and automotive industries which would lead to greater fuel economy in motor vehicle operation with a resultant great saving of petroleum reserves as well as a one-third reduction in the cost of automotive transportation. He described the experimental 12.5:1 compression ration engine giving from 33 to 40 percent higher economy, which had been run in cars in the Detroit and Dayton areas, and pointed out that for every three oil wells required today, only two would be required to keep the cars of tomorrow operating the same mileage.

Delivery of the paper marked the thirtieth anniversary of a paper similarly entitled, "More Efficient Utilization of Fuels," presented by Mr. Kettering before the SAE and is the culmination of a long series of developments in automobile engines and fuels in the intervening years. Mr. Kettering declared that in the last thirty years the petroleum chemist and the automotive engineer have made fuel and engine improvements which have saved the public one-third—one billion dollars a year—in their gasoline bill. A saving of another one-third of the gasoline consumed in motor vehicles and another billion dollars yearly can be made through additional cooperative research and engineering, he said.

"But these engines and fuel developments are in the laboratory stage," he emphasized, "and how soon they can be incorporated in the automobile will depend upon a large amount of development by both the automobile and petroleum industries working toward a common goal. The jump from 6.5 to 12.5 compression ratio cannot be made at once for various reasons. There are 30,000,000 vehicles on the road today which do not require high octane gasoline and which must be kept going until they are worn out.

"While this work has demonstrated that these improved engines are possible to build and no insurmountable obstacles lie immediately ahead, and while it is certain gains in engine efficiency can be obtained in the near future, the jump from present engines to very high compression engines can be taken only in steps. As the petroleum industry makes an improvement in fuels, the automobile industry can supply a higher compression engine to utilize them. This process of continued improvement with each new model is the method used to introduce new improvements in the past, and it is the way they must come in the future."

FUTURE WORLD SUPPLIES OF ENERGY SURVEYED IN REPORTS TO A. P. I.

THE petroleum industry will study the future supply of energy available to mankind more carefully than ever before at the 28th annual meeting of the American Petroleum Institute. The study will concern itself with the availability of oil for the next year and the next generation. It will concern itself with national policy as to the utilization of all the fossil fuels, coal, natural gas and oil. And it will concern itself with the nine "continuous" sources of renewable energy on which the world will have to rely to supplement its fossil fuels in future generations.

Aside from these forward-looking inquiries, the Institute will consider, as always, current technical problems of every branch of the industry. It will give thought to the industry's relations with the consuming public and with government.

Because of the intense interest in the subject matter of the meeting it is thought that attendance will be greater than ever before. In 1947 registration totaled 4,750, and it is anticipated that the figure may exceed 5,000 this year if housing facilities are adequate.

Because of its paramount interest in immediate supplies of gasoline and fuels, the marketing division of the Institute has scheduled a discussion of the current supply position at its annual group meeting. Chairman of the marketing session will be B. L. Majewski of Deep Rock Oil Corp. Robert G. Dunlop, president of Sun Oil Co., Philadelphia, will discuss short-term production from the economic standpoint in an address before the entire Institute, which he has titled, "Three Peas in a Pod: Prices, Profits, Productivity in Petroleum."

The perhaps more pressing problem of oil supplies in the more distant future will be dealt with at the general session on Nov. 11 by L. F. McCollum, president of Continental Oil Co. and chairman of the National Oil Policy Committee's subcommittee on Long-Term Availability of Crude Oil Supply.

A paper which is expected to create a vast amount of interest among businessmen and scientists in every industry is to be presented before the division of Refining by Eugene Ayres of Gulf Research and Development Co., Pittsburgh. The respect with which the program makers view his subject, "Major Sources of Energy," is indicated by the fact that the division has scheduled no other speaker for its Tuesday sessions. Mr. Ayres has spent two years in the preparation of the paper, and current plans are to have it published in book form after the presentation.

L. F. McCollum

Eugene Ayres

Mr. Ayres gives the present era a new name. He calls it the age of fossil fuels. In doing this he combines the unrenewable fuels such as coal, petroleum and natural gas. The magnitude of reserves of these fuels is discussed along with the reserves of fissionable materials, which he shows to be relatively limited. Predictions are made regarding the life expectancy of fossil fuel reserves and the nine "continuous" sources of energy are analyzed.

All of the energy which man has learned to convert to useful work is of atomic origin and from the sun, he points out. The most convenient sources of energy are the "stored sunlight" of the fossil fuels and hydroelectric power. For the future, however, man will have to depend increasingly on solar energy, the earth's heat, vegetation, tropical waters, tides, atmospheric electricity, wind and the heat pump, Mr. Ayres suggests.

In 1947 it is estimated that the world production of major fuels was 21.4 trillions of horsepower hours. Of this 15.0 trillions was coal and 6.4 petroleum. The United States with seven percent of the world's population produced 49 percent of the world's major fuels; 43 percent of the coal and 63 percent of the oil.

In considering the nine "continuous" sources of energy available to the earth, Mr. Ayres attempts to evaluate each and suggest what proportion might be utilized at the end of 100 years of development. As indicated in the following tabulation, he estimates that 1.7 trillions of horsepower hours per year are now utilized, and that within 100 years this might be increased to 41.9 trillions or to nearly twice the world consumption at the present time.

CONTINUOUS SOURCES OF ENERGY

Energy in Trillions of Horsepower Hours Per Year

	Maximum Available	Now Used	Possible Within 100 Years
Vegetation	60	1.0	10.0
Solar collectors for power	17,000	Trace	20.0
Solar collectors for space heating	9*	Trace	4.5
Waterfalls	360	0.7	6.0
Wind	2	Trace	Trace
Heat pumps	2	Trace	0.2
Tropical waters	20	—	0.7
Earth heat	200	Trace	0.5
Tides	13	—	0.5
Atmospheric electricity	10	—	—
Total	17,676	1.7	41.9

* This is the amount of energy now required for space heating. More than this amount is, of course, theoretically available.

"The estimates in the table of what may be possible during the next century are, of course, matters of personal judgment," Dr. Ayres points out. "No two men would guess the same figures, but there is likely to be fairly general agreement on orders of magnitude. From these estimates it appears that we may soon obtain a substantial part of our energy requirement from continuous sources instead of from limited reserves. At the present time continuous sources account for almost seven percent of our energy (wood and hydroelectric power), and another seven percent could come within the next decade by the extension of hydroelectric installations and solar space heating. Still further extension of these two sources alone could account for a third seven percent in the following decade, without considering the smaller increments that may come from other continuous energy sources; but,

R. H. Hargrove

for very substantial gains, our reliance must be upon collectors of solar power.

"This does not mean that we would not be using coal and petroleum. The requirements of the world will increase very rapidly. The net effect of the development of continuous sources will be that we shall finally reach the point where it will no longer be necessary to deplete our fuel resources at an accelerating rate. It is unlikely that energy can be obtained from continuous sources at costs lower than the cost of producing fossil fuels. The effect of new developments upon prices of fuels should be to retard the abnormal price increases stimulated by scarcity—the sort of price increases that would inevitably result in increased demand."

Another challenging paper dealing with the national supply of energy is that of R. H. Hargrove, president of Texas Eastern Transmission Corp., Shreveport, La. In this paper he says: "A farsighted view of the fuel industries' responsibilities must acknowledge that they, as public servants, have the duty and responsibility not only of supplying the peacetime demands of our nation for energy, but of supplying them in such a way that the industries may hold themselves ready to fulfill their part in national defense, should the need arise.

"What does that mean in terms of practical action today? It means that, as a group, the fuel industries should cooperate to plan their marketing, production and processing to supply the public demand for energy and yet maintain a position which will not be too vitally disrupted by the impact of war. It means that the industries' views and approaches must be sufficiently broad to encourage the joint serving of markets heretofore more or less exclusively served by one industry; so that, should peak demands skyrocket, either through increased civilian or military production, the combined facilities of the fuel industries may be adequate to the need, rather than find a single industry unable to cope with the demand. It may mean the withdrawal from or de-emphasis on some types of markets by one industry in favor of another industry; it may mean the sharing of markets in open competition."

Mr. Hargrove shows that the full potential demand for natural gas today cannot possibly be supplied because of its low price and convenience when compared with coal. Natural gas costs about the same per million Btu's as coal and, when burning efficiencies are considered, is a far cheaper source of heat. Naturally everybody wants gas.

From the standpoint of the public interest Mr. Hargrove suggests that coal should assume a greater share of the market for space heating than it has today. This will be accomplished only if selling prices of the various fuels are permitted to seek their own competitive levels and not with one fuel regulated in price as is gas today, he points out.

Expanding his suggestion that the oil industry should encourage the use of gas in the space heating market, Mr. Hargrove says: "I mean by this that the oil industry should begin gradually and yet definitely to de-emphasize the household and commercial heating aspects of their marketing and should further encourage and aid the natural gas industry to secure the necessary steel and equipment to assume some of the burden of supplying the demands which the oil industry will discourage. It is a process which cannot be completed overnight. We have already seen that the gas industry's demand far outstrips the capacity of transportation facilities today. Obviously, then, we cannot immediately assume an additional heating burden from the oil industry. Nor would the economic interests of the oil industry be served by shifting that responsibility immediately. It is a process of years—a gradual, progressive shifting of service. But that is precisely the point I should like to make. If it is not an overnight process now, it will likewise not be an overnight process five years or ten years from now. In order to bring it about in five or ten years, we must start now."

To accomplish the shift in markets and the reallocation of the heating load, Mr. Hargrove suggests that the three industries—oil, natural gas and coal—should cooperate in planning their marketing, production and processing.

In its technical sessions the Division of Refining will devote two meetings to a review of rapid methods of analysis. The Division of Production will conduct one symposium on offshore drilling methods and one on cementing practices. Three group meetings will be held by the Division of Transportation to deal with various current problems. As usual, fire protection, accident prevention, public relations and lubrication will be considered at group sessions.

Throughout the United States Oil Progress Day was celebrated by the industry on October 14 with civic luncheons, inspection trips through oil properties, radio talks and by other publicity means. The accompanying photograph shows one example. At Oklahoma City a portable rig set up in front of the municipal auditorium drew interested crowds throughout the day. A special Oil Progress Day luncheon was followed by an inspection of the rig by business men. After school, children were treated to a demonstration of how an oil well is drilled. At Atlanta, Ga., Plantation Pipeline Co. held open house. At Elizabeth, N. J., Standard Oil Development Co. dedicated its new research center and followed with a dinner in New York for seven hundred with an address by Dr. Carl T. Compton, president of Massachusetts Institute of Technology.

OIL PROGRESS DAY CULMINATES YEAR'S INFORMATION PROGRAM

October 14th is Oil Progress Day
Being on the job for you is our most important job...
"How are things in the oil business? Mister, let me tell you...
"Oil Progress Day"...is every day!
Never before has America used so much oil!
Oil Companies Compete in a race You always Win!

Advertising was prepared for individual company use by Oil Industry Information Committee.

THE oil industry's information program is rounding out its second year of operation with an outstanding 1948 record of achievement in three important projects. The past year's accomplishments reflect the industry's action through thousands of companies.

Last winter it conducted a conservation campaign which helped to head off a threatened fuel "crisis" by informing the public of the true situation and enlisting its support in a drive to "use oil wisely and efficiently." During the spring and summer, further conservation activities greatly strengthened friendly relations between oil men and farmers. This fall the program carried to completion the first nationwide effort ever made by an industry to tell its story of progress and public service to citizens of communities. This was accomplished through the observance, on October 14, of "Oil Progress Day," which probably was the most successful informational event ever carried out by an industry.

Reports which poured in to O.I.I.C. headquarters immediately after "Oil Progress Day" indicated beyond question that active participation by companies, trade associations, equipment manufacturers, jobbers, dealers, and service stations far surpassed all previous program records. From Florida to Washington and from Maine to California, oil men by the thousands used their own initiative in planning and executing observances which called attention to the contributions which the industry has made over the years to the growth and prosperity of cities, towns and villages.

A sampling of "Oil Progress Day" results in representative areas shows that, in addition to parades; luncheons for civic leaders; open houses at refineries, research laboratories, wells, service stations and even pipeline terminals; extensive use of radio; addresses by oil men; newspaper and billboard advertising; and distribution of literature, unusual and clever ideas were executed all over the country.

Governors of New Jersey, Massachusetts, Maine, Rhode Island, New Hampshire and Colorado were among state executives who issued proclamations or statements calling the attention of citizens to the benefits which are derived from the progressive spirit and the competitive nature of the oil business. Stores arranged window displays of petroleum products. In at least two cities, wells actually were drilled to show the public how the job is done. An exhibition of offshore drilling in the Gulf of Mexico was presented by one company.

Dr. Karl T. Compton, president, Massachusetts Institute of Technology, was guest speaker at the "Oil Progress Day" dedication of a huge new research laboratory in New Jersey.

New England, which is largely a marketing area, devoted "Oil Progress Day" observances to the important role which dealers and jobbers play in the petroleum business. In New York City, the "progress report" was made to auto drivers by dealers at hundreds of service stations. The little town of Cuba, New York, where a French missionary first found oil seepages in North America three centuries ago, made a big occasion out of "Oil Progress Day." So did Titusville, Pa., where the first oil well was drilled by Colonel E. L. Drake in 1859.

A theater in Mount Jackson, Va., was given over entirely to the observance, providing free movies, including an industry film; entertainment and an address for 800 community and farm leaders and rural youth.

Atlanta oil companies closed their offices early so

Ralph C. Champlin, Chairman,
Oil Information Committee

that 1,200 employees could attend a meeting at the City Auditorium and hear talks and the presentation of prize winners in an "Oil Progress Day" poster contest.

Luncheon meetings for 250 persons each were held in Columbia, S. C., Tampa, Fla., and Macon, Augusta, Columbus, Albany and Savannah, Ga. The Savannah meeting was preceded by a parade and included an address by the mayor and selection of the city's four most progressive girl students.

Hundreds of thousands of "Oil Progress Day" lapel buttons were worn in New England, the Southeastern district and other parts of the country.

Forty-five thousand Omaha, Neb., school children, and students in 2,200 Colorado schools saw a petroleum film or discussed the oil business and its progress. Fargo, N. D., held an exhibit of oil equipment in the town square. Winona, Minn., oil men presented a new fire engine to the city as a token of appreciation. Several leading newspapers published special "Oil Progress Day" sections.

Several cities liked the progress day idea so well that they had observances all week, with various civic groups sponsoring special events on successive days. State fairs held several weeks after the official date elaborated on the theme. Also, at the Washington National Airport, Al Williams, famous Navy pilot, and the oil company for which he works, highlighted petroleum's contribution to aviation progress by presenting the "stick" of Al's record-making Grumman fighter plane to the Smithsonian Institution. Wholehearted cooperation in preparation for the observance was obtained throughout the nation as companies, trade associations and individual oil men were urged to participate actively. Editorial material ranged all the way from an attractive brochure to feature stories for newspapers and pattern speeches, radio interviews and spot announcements. A special advertising campaign was prepared for use in the oil trade press, newspapers and national media.

All in all, it can be said that "Oil Progress Day" carried the story of petroleum's public service to millions of persons in thousands of communities. Newspaper and radio coverage of the event blanketed the nation, while residents of communities everywhere became personally acquainted with oil men. At the same time, the observance rallied company and trade association participation behind the program to a degree never before accomplished.

From the time the program was inaugurated in November, 1946, until last September 24, a total of 13,360,094 pieces of O.I.I.C. literature was distributed to the public. That is a very respectable number indeed, BUT, from September 24, when the first "Oil Progress Day" material left New York, until October 8 ,total distribution of editorial material was almost 15,000,000 pieces, shipped to more than 3,500 points. From those places it was distributed to additional communities.

More than a thousand speeches were made on "Oil Progress Day," including many by top executives of companies; hundreds of mayors issued proclamations; thousands of hours of radio time were devoted to the nationwide observance; at least 100,000 school children were reached with special messages; more than 1,000 billboards were used in Kentucky; several hundred prints of the film "How Oil Supply Meets Demand" were displayed; more than 200,000 streamers carrying the message "There's A Plus For You In Petroleum's Progress," and almost 100,000 of the posters "Where There's Progress There's Petroleum" were posted by service stations, jobbers and dealers.

The success of this year's program in approaching its long-range goal of bringing about better public understanding of the oil business and thereby serving the common interests of all Americans by helping to maintain a free, competitive economy for the nation does not rest solely upon the achievements of "Oil Progress Day," however. The groundwork was carefully laid during the conservation campaigns of last winter, spring and summer, when a great deal was done to build up public confidence in the integrity and progressive nature of the industry.

When the program was launched two years ago, it will be remembered that the O.I.I.C. (then known as the Public Relations Operating Committee, or P.R.O.C.) made a decision to devote one full year mainly to obtaining industry-wide participation in its activities. This was little enough time, in vew of the fact that the committee was attempting something new in public relations—a program conducted by autonomous committees of oil men rather than one directed by a centralized headquarters staff. It was felt that only after that difficult task had been accomplished through the setting up of a unique type of operational technique should any extensive approach be made to the public at large.

It was only a few month later, however, in the early summer of 1947, that the threat of a possible winter fuel shortage made it necessary to start talking directly to the American people. The work of setting up twelve independent committees of representative oil men in what were roughly the old P.A.W. districts was rushed to completion and put to work.

The impending danger rallied more than 1,000 companies behind the program in record time. Committee organization right down to the area level went ahead much faster than had been anticipated. Time was found to issue basic literature, such as the popular "Public Relations Manual," two detailed guides showing company executives how to reach their employees, and other material.

The first step to inform the general public of the anticipated tight supply situation was taken through the publication and distribution to company executives, trade associations, magazines and newspapers throughout the country of a booklet entitled "Current Facts on Supply and Demand." This booklet, which surveyed the outlook on the basis of latest statistics available to the industry, prepared the field for the intensive conservation campaign which developed progressively during the intensely cold winter months and lasted well into the summer of 1948. It proved conclusively that the industry was doing everything possible to increase supply to meet unprecedented postwar demands for oil. It provided material for hundreds of well-informed news stories and editorials. In fact, "Current Facts" became such an important medium of in-

formation that several new editions have been issued.

As the months passed the program redoubled its efforts to explain what was being done to keep America warm and the wheels of its motor vehicles and industry turning. Scores of leaflets, advertisements, radio scripts, pattern addresses and other type of literature were prepared and widely distributed. Many companies tied in their own advertising with the drive. Committeemen cooperated with fuel coordinators, with radio stations, with the Advertising Council and other groups working on the situation.

The results of the campaign were manifold. Coordinators have given full credit to the industry for the fact that comparatively few shortages occurred, due both to its superhuman efforts to increase supply and to program appeals which induced the public to cut down its use of fuel, in some cases as much as ten percent. Conservation literature was well received and widely read —one piece, entitled "Questions and Answers on the Need to Save Fuel Oil" attained a circulation of 3,225,505. Subsequent opinion surveys showed that a large majority of the public did not blame the industry for shortages which did develop. Finally, the drive attracted such widespread support by companies and associations that O.I.I.C. district membership jumped from 1,000 to almost 4,000.

When the home fuel situation eased due to the coming of warm weather, program activities were directed toward informing farmers of petroleum's efforts to meet their needs for ten billion gallons of fuel annually and to helping them in making the most efficient use of their power machinery.

Plans for this campaign were completed at a conference held at Kansas City in March and attended by farm leaders and representatives of equipment manufacturers and oil companies from all part of the country. They were carried out by the twelve district committees through area meetings, direct contacts between dealers and farmers and special advertising and literature. The scope of the effort it indicated by the fact that an illustrated "Efficiency Guide" prepared to show agriculturalists how to make the best use of tractors and other mechanized equipment, has had a distribution of 2,181,807 copies to date and is still in great demand.

As the year advanced and the supply and demand problem was solved, the O.I.I.C. turned its attention to the task of broadening and strengthening long-range operations. One of its decisions was to concentrate on the observance of "Oil Progress Day." Others were: (a) to continue the "wise and efficient use" campaign in areas where deficiencies might still develop due to work stoppage, transportation tie-ups or to another unusually harsh winter; (b) to press for even greater industry participation; (c) to activiate every one of the 4,000 committee members; and (d) to outline a further expansion of the industry's program to reach larger segments of the public at the community level.

Meet the men who broke the records...
RESEARCH
PRODUCTION
REFINING
TRANSPORTATION
DISTRIBUTION
Ears tuned to the hum of America... alert to your everyday needs... their all-out continuing efforts are aimed at one goal— MORE OIL FOR YOU
THESE MEN ARE TYPICAL of the millions of men and women in the oil industry who have gone out and shattered every record in supplying oil for America. They are representative of the more than 34,000 individual companies whose competition in oil production, refining, transportation and distribution has led to more oil for you — to fill the greatest demand for petroleum America has ever known.
RIGHT NOW, they're supplying you with almost 250 million gallons of oil products every day. This is more oil than has ever been supplied before... more oil than was needed in the peak years of the war!
The demand for oil is constantly expanding because of the ever-increasing number of cars and trucks... farm tractors and oil burners... planes, trains, ships and factories.
How Competition in Oil Helps You
The men and women in the oil business are working day and night to step up the supply. And the individual oil companies—competing in the traditional manner of American industry—are now investing over 4 billion dollars for new facilities to make more oil available for you.
Here's how oil consumption has increased—Because America has more cars and planes, more Diesel trains, farm machinery and oil burners—our consumption of oil has nearly doubled in the last ten years. Currently, the industry is supplying oil at a rate exceeding 90 billion gallons per year.
are being done so that you will get the oil products you want... when and where you want them!
Outlook For The Future
The nation's oil needs are being met. What's more, the industry is gearing itself to meet the even greater needs anticipated for tomorrow. For the all-out job to supply you today has resulted in the largest stock of underground oil reserves in the history of the nation!
YES, THESE MEN — and almost 2,000,000 others like them—will continue to supply you with high-quality oil products in ever-increasing volume...
October 14th is Oil Progress Day
This is the day when local oil men will report to their friends and neighbors on what is being done toward community progress and the well-being of America.
OIL FOR PROGRESS
A Report to the Communities of America
October 14, 1948

OIL INDUSTRY HAS MET THE TEST OF A DECADE OF DIFFICULTIES

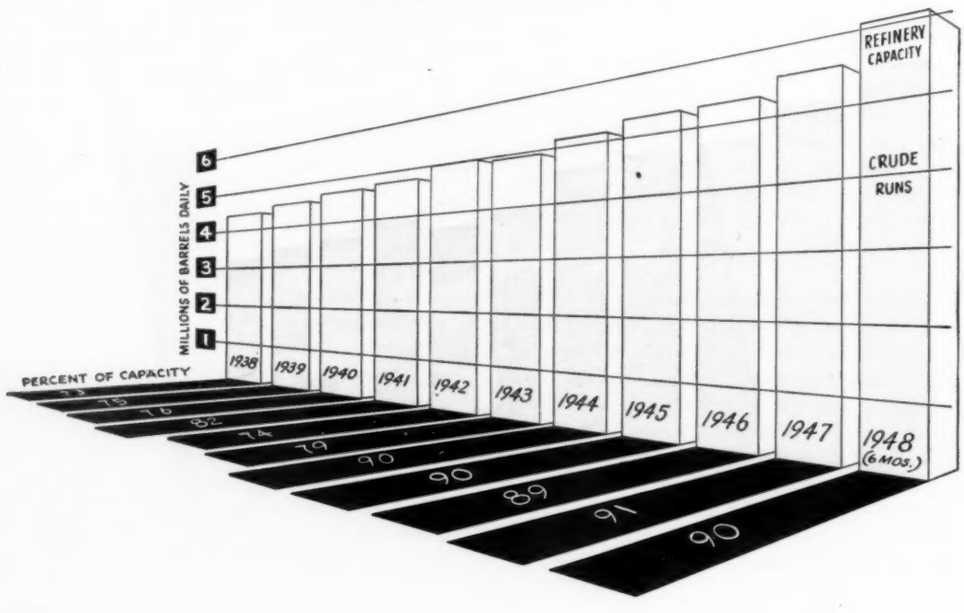
FOR almost a decade the oil industry has been operating under conditions that could be described only as abnormal except that emergencies seem to have become its regular portion. From the outbreak of World War II in Europe disruption of long-established trade relations, dislocation of trade routes, sudden enormous requirements of products previously in small demand and rapid readjustments to meet sudden and unexpected needs have followed one another. It is a remarkable tribute to the resourcefulness and enterprise of the industry that it has been able to respond successfully to the heavy and unforeseen calls made upon it.

The record of these years and their experiences should inspire confidence in the ability of the industry to meet future emergencies as they arise and should quiet the fears of those who feel that some new form of governmental control and regulation should replace the system of free competitive enterprise under which the industry has flourished and grown to greatness. If it were possible to close one's mind to the events that have taken place and step back a brief ten years to 1938, a forecast of what actually was in store would have been set down as both impossible and unbelievable. A brief look backward may serve to inspire greater fortitude as to the unknown developments that lie ahead in the near future.

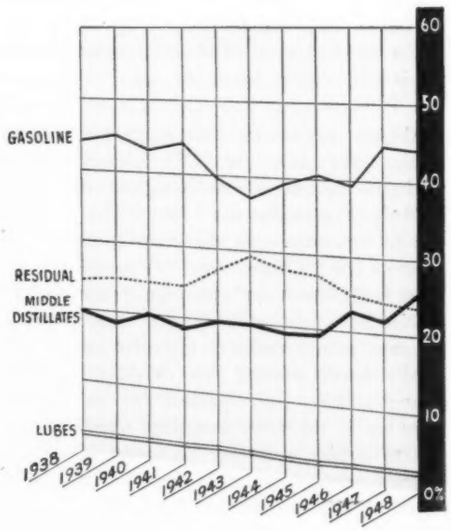
Ten years ago the known petroleum reserves of the United States were estimated by competent authorities at a little over fifteen billion barrels, sufficient at the then current rate of consumption to satisfy requirements for approximately fifteen years. There were many both in and outside the oil industry, however, who took a pessimistic view of the future. The decade then ending had witnessed the discovery of a succession of fields of huge potentiality including the greatest of all, East Texas. It was unlikely, the doubters held, that many, if any, more reservoirs of such dimensions could be found. The period of easy discovery was over, they held, and while new fields would still be located, they would be of relatively small extent and incapable of meeting the growing requirements of the country.

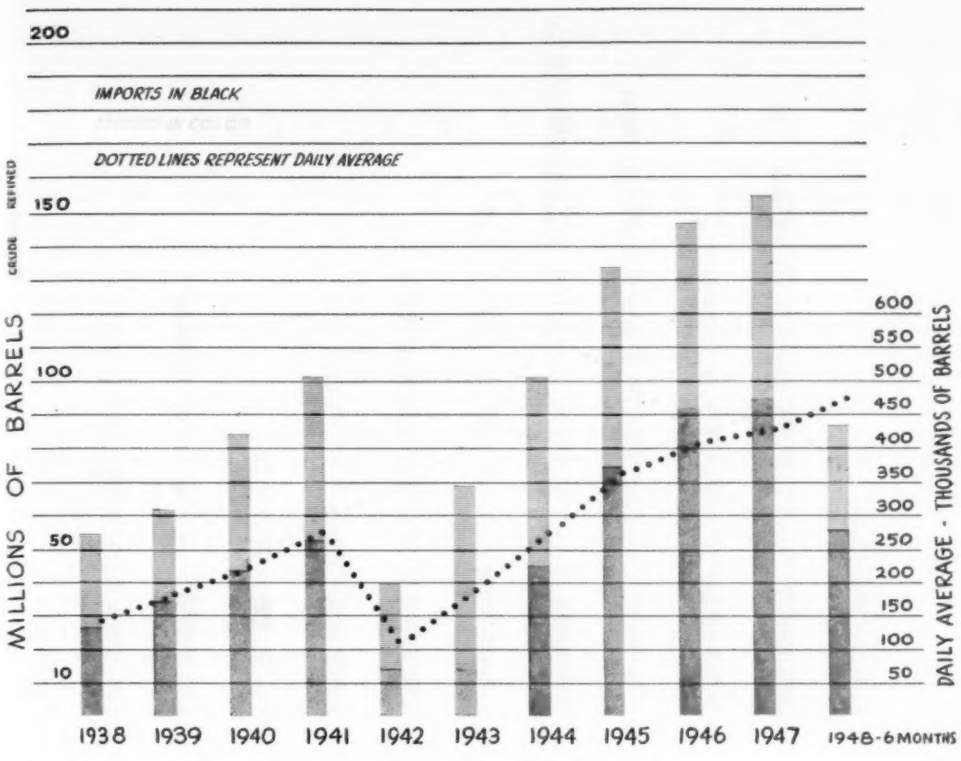
To an extent this opinion has been verified. Few fields of the first magnitude have been discovered in intervening years. Yet we find that at the beginning of 1948 proved reserves of crude oil were 21.5 billion barrels, a gain of 38 percent over 1938, despite withdrawals of 15 billion barrels in the period. If we adopt the present method of computing all liquid hydrocarbons from which petroleum products can be obtained, the total proved and unused supply at the beginning of

Capacity of U.S. refineries and percent of capacity operated.

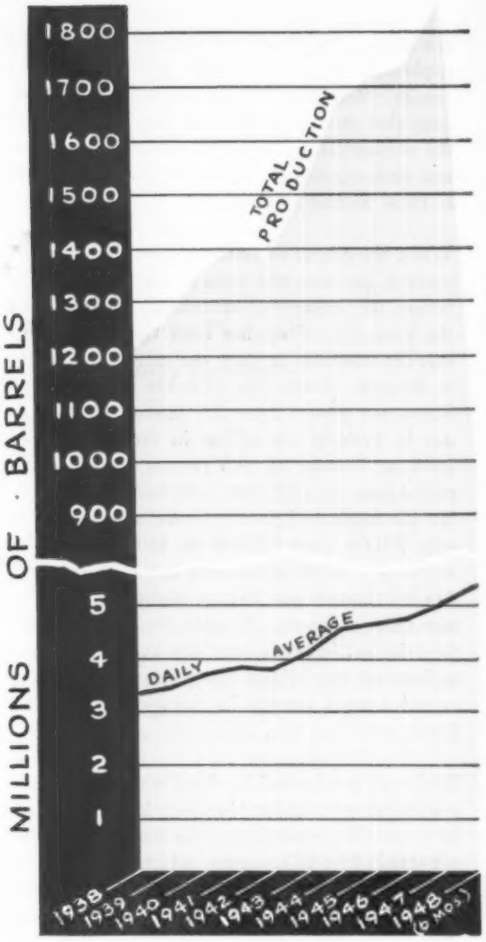


Yields of principal products.





Trend of imports and exports of petroleum and products.

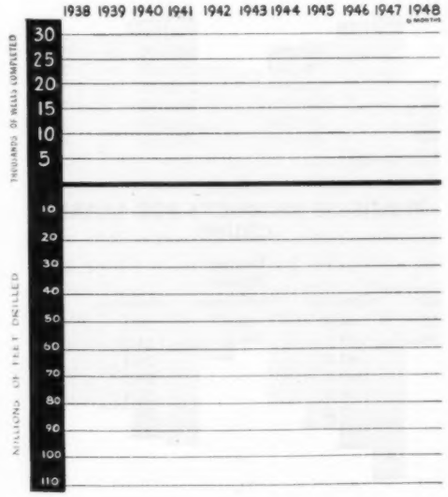


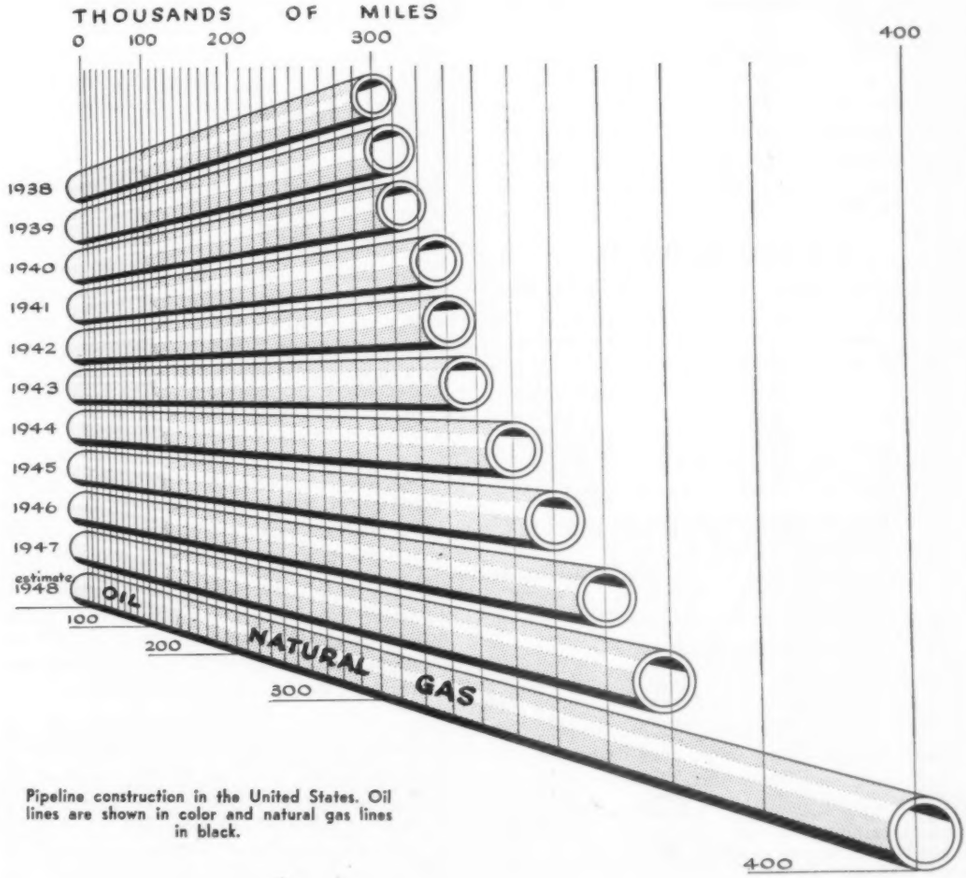
Daily average and total annual U.S. crude production.

the present year was 24.7 billion barrels, or enough to cover national requirements for approximately the same number of years as the known supply ten years before.

Past history of the oil industry shows that activity in exploration and consequent discoveries increase whenever the rewards of success become sufficient to justify the risks of this hazardous pursuit and decline when prospects are less encouraging. With scientific surveys at an all-time peak, 1948 promises to make a larger addition to known reserves than any recent year. While it is recognized that oil is a wasting asset, the weight of geological opinion supports the view that future discoveries for a generation or more to come will continue to be governed by the same economic considerations as in the past. An inviting new field of venture is provided by

Wells drilled and total footage.





Pipeline construction in the United States. Oil lines are shown in color and natural gas lines in black.

the broad areas of offshore waters, where marine exploration is just beginning to show important results. Beyond all this is the comforting knowledge that steady progress is being made toward the commercially practicable utilization of shale and coal deposits to supplement liquid resources as these become inadequate.

While the extent of reserves, known and undiscovered, has been and remains a question for the future, the problem of immediate importance for the producers of oil has been the provision of supplies adequate to meet the extraordinary rise in demand. Production of crude in the United States has grown from 3.3 million barrels per day in 1938 to 5.4 million in the first half of 1948, an increase of 54.5 percent. During this period more than 250,000 wells have been drilled, but the number of productive wells has increased only 70,000 from 370,000 to 440,000. In the world as a whole production has risen from 5,445,000 barrels per day to slightly more than nine million barrels. Outside the United States the principal increases have been in the Caribbean region and the Middle East, war having interrupted normal growth in Europe and the Far East.

While oil production in the United States has grown by vast strides, doubling in the span of 14 years, the proportion of the total world output supplied by this country, which has averaged about 65 percent over the life of the industry and rose to roundly 70 percent under the stress of the late war, has fallen to 60 percent in 1948. This trend may be expected to continue, and it is desirable that it should do so. It would be illogical to expect that an area containing a probable one-sixth of the world's petroleum resources should continue indefinitely to provide four-sixths of its supplies.

With the coming of war demands upon the oil industry were sharply increased by heavy requirements for military use, while at the same time the means of expanding supply were sharply curtailed. Although oil ranked as a war industry and so rated a preference on certain strategic materials, the multiplicity of demands from many directions led to shortages both of mechanical and manpower. The number of new wells put down during the first two years after the United States entered the war fell off roundly one-third, due to inability to obtain sufficient steel and lack of drilling crews. Depredations by enemy submarines suspended tanker operations and threw the burden of moving oil from the Mid-Continent and Gulf Coast to eastern seaboard areas entirely upon the railways. The country's refineries, which formerly had had 20 to 30 percent of unused capacity, suddenly were called upon to process an additional million barrels of crude oil daily and to supply a great volume of new products. Conversion of the refining industry to a war basis involved the development and installation of new processes and a construction program backed by government financing that called for the investment of roundly a billion dollars.

In spite of tremendous handicaps the oil industry was able to meet every demand made upon it and by the end of the war was producing, moving and refining a million barrels per day more oil than at its beginning. Its performance during this period stands as an epic chapter in the history of American industry.

Among oil men there was virtual agreement that the end of hostilities would be followed by a sharp though temporary drop in demand for petroleum products. It was assumed that discontinuance of a major part of military requirements, together with the inevitable delay in restoring automotive plants to peacetime production, would put consumption back to about its level in 1941 from which it would begin a new upswing.

Instead of this anticipated respite, demand continued to rise from its wartime dimensions, practically without a break. Consumption in 1946 was higher than in the preceding year when active combat was still under way. In 1947 and 1948 demand has expanded at a rate nearly double that of the prewar period with every indication that this growth will continue unabated for the next several years at least.

To keep pace with this expansion in demand the oil industry has stepped up its exploratory work to a new high, has expanded drilling operations by nearly 40 percent, has projected the building of some 25,000 miles of pipeline which will be laid as rapidly as materials can be supplied. Its program of refinery enlargement calls for the yearly investment of roundly a billion dollars or practically the same amount as was required for its conversion to a war machine.

In a way the task of meeting postwar requirements has imposed a greater strain upon the oil industry than did the wartime expansion. The necessity of undertaking a vast broadening of facilities at a time when construction costs are double or triple their earlier proportions is requiring a capital investment of unprecedented dimensions. To maintain operations on this higher cost level will require that prices both for crude and products remain at levels well above those of the prewar period. Regardless of cost, however, the oil industry is doing its job, and the success with which it has met and overcome its latest emergency adds another to its long record of outstanding achievements.

U. S. PRODUCTION
(Thousands of Barrels)

Year	Production	Daily Average
1938	1,214,355	3,327
1939	1,264,692	3,465
1940	1,353,214	3,700
1941	1,402,228	3,842
1942	1,386,645	3,790
1943	1,505,613	4,125
1944	1,677,904	4,600
1945	1,713,655	4,698
1946	1,733,424	4,749
1947	1,856,098	5,085
1948 (6 mos.)	989,115	5,405

U. S. DRILLING RECORD

Year	Wells Completed	Footage Drilled
1938	27,493	84,853,600
1939	27,717	85,922,700
1940	31,149	96,182,600
1941	32,510	99,347,700
1942	21,990	67,903,050
1943	20,349	61,991,800
1944	25,786	84,378,450
1945	26,649	92,982,100
1946	30,221	101,010,500
1947	31,690	110,230,000
1948 (mos.)	18,010	62,245,000

TEN YEAR REFINING RECORD
(Thousands of Barrels Daily)

Year	Ref. Capacity	Crude Runs	Percent of Capacity
1938	4,351	3,192	73
1939	4,508	3,391	75
1940	4,629	3,546	76
1941	4,719	3,861	82
1942	4,957	3,655	74
1943	4,902	3,889	79
1944	5,093	4,563	90
1945	5,301	4,711	90
1946	5,316	4,740	89
1947	5,569	5,074	91
1948	6,034	5,462	90

Figures of capacity are for January 1 of each year. On January 1, 1946, new construction representing added crude capacity of 367,250 barrels daily was under way, some portion of which has since gone into operation.

OIL TRADE OF U. S. IMPORTS
(Thousands of Barrels)

Year	Crude	Refined	Total	Daily Average
1938	26,048	27,837	53,895	148
1939	34,106	27,350	61,456	168
1940	43,085	40,534	83,619	229
1941	52,029	48,564	100,563	276
1942	13,540	25,780	39,320	108
1943	13,808	54,325	68,128	187
1944	44,846	55,663	100,509	275
1945	74,127	59,275	133,402	365
1946	91,459	55,182	146,641	402
1947	94,190	60,490	154,680	432
1948 (6 mos.)	55,262	31,311	86,573	473

OIL TRADE OF U. S. EXPORTS
(Thousands of Barrels)

Year	Crude	Refined	Total	Daily Average
1938	77,254	51,030	128,284	351
1939	72,064	54,053	126,117	346
1940	51,599	31,864	83,403	229
1941	34,484	75,502	109,986	300
1942	35,560	88,073	123,633	339
1943	43,313	108,615	151,928	416
1944	34,802	173,378	208,180	570
1945	35,353	151,275	186,628	511
1946	42,574	108,500	151,074	414
1947	37,200	124,780	164,980	452
1948 (6 mos.)	19,075	46,223	65,298	357

PIPE LINE MILEAGE
Crude Oil, Products and Natural Gas

Year	Oil	Natural Gas	Total
1938	119,100	182,300	301,400
1939	122,500	186,800	309,300
1940	124,500	190,300	314,000
1941	131,900	195,100	327,000
1942	132,600	198,800	331,400
1943	135,100	202,800	337,900
1944	140,100	210,300	350,400
1945	141,900	218,400	360,300
1946	147,200	224,600	371,800
1947	149,700	230,000	379,700
1948*	156,000	250,000	406,000

* Estimated

YIELDS OF PRODUCTS FOR BARREL CRUDE
(Percent)

Year	Gasoline	Middle Distillates	Residual	Lubes
1938	44.2	19.9	24.4	2.6
1939	45	18.6	24.7	2.8
1940	43.2	19.9	24.4	2.8
1941	44.3	18.6	24.3	2.8
1942	39.9	19.8	26.9	2.9
1943	37.2	19.8	29.2	2.7
1944	39.5	19.1	27.7	2.5
1945	40.7	19.2	27.3	2.4
1946	39.6	22.6	24.9	2.6
1947	44.7	21.6	24.1	2.6
1948	44.6	25.2	23.6	2.6

WESTERN CANADA MAY BECOME OIL EXPORTER

Years of Exploration by Geologists and Geophysicists and Millions Spent on Wildcatting the Plains of Western Canada are Beginning to Pay Off. The Redwater Discovery Followig Leduc Insures Continuation of an Active Search.

By J. L. Irwin

IF the statement had been made early last year that export of Alberta oil to the United States in the near future was a possibility, it would have been met with ridicule. Such a statement, however, has now been made, less than two years later. It was made by H. H. Hewetson, president of Imperial Oil Limited, at a banquet given in his honor by the Edmonton Chamber of Commerce on Thursday, September 23. Coming from so high a source, coupled with all that has happened in Alberta oil development in the past twelve months, this utterance, needless to say, has been generally accepted.

Appearance of the Redwater discovery, some 45 miles to the northeast of Edmonton and 60 miles northeast of the Leduc field, at the beginning of September is no doubt largely responsible for Mr. Hewetson's statement. Redwater is roughly 15 miles north of Fort Saskatchewan and eight miles north of the Saskatchewan River. Discovery was made at a depth of 3,131 feet in the Devonian limestone, 1,000 feet shallower than had been expected, yielding oil of 34° gravity and with all indications of an extremely good producer. Coring and testing have been carried out carefully since the discovery. The well is being deepened with last depth reported at 3,234 feet. Depth of porosity is given as 140 feet by the last report. At this shallow depth light drilling rigs can be used and drilling time should be half of that of Leduc. No official statement on volume of production has yet been made.

With such porosity opinions have been given that the well pierced the apex of an anticline. With the knowledge of gentle slopes, should this be the case, a wide productive area would be indicated. Further information covering proven acreage and potentials must await additional drilling which it is understood will be carried out immediately. In the meantime Redwater stands out as the most important discovery made since the Leduc field came into being in February last.

Mr. Hewetson stated that if the Redwater discovery developed as a structure pointing to a large reserve, Alberta crude may in the near future find a ready market in the United States. Movement of this crude through a large pipeline to Regina and from Regina through a second pipeline into this area is now being planned. This would benefit not only Alberta but Canada's economy in general by reducing importations and by providing a better trade balance with the United States.

The United States, he remarked. had this year become for the first time an importer of crude oil. By 1950 it was estimated that Canada's prairie oil requirements should be satisfied by home production, making it possible to export surplus supplies. To carry this out efficiently, programs such as the construction of the large pipeline to Regina and one over the border should be prepared and carried out in advance.

Edmonton, Mr. Hewetson remarked, was likely to become one of the great oil centers of North America. With its growth every city and town in the province would benefit. Edmonton's refinery, now in operation, and the one in Regina would be enlarged to increased capacity. It was hoped that additional capacity from other refineries would materialize. Extension of the Edmonton-Regina pipeline into the United States would be more effective, he stated, than pipelines to the head of the lakes or to Vancouver, though these might appear later. The importance of Lloydminster's heavy crude would grow with expansion of its exports to the United States, eastern Canada and the Pacific Coast.

With 50 oil survey parties now in operation in Alberta, he said, this area now takes third place on the continent in the matter of active oil exploration work. More fields and, therefore, more reserves, were expected to materialize from this. They would bring additional problems and additional benefits including benefits to individual companies and to the general public.

Mr. Hewetson concluded by expressing his belief in individual enterprise and free competition, opposing monopoly in any form. Immense sums of risk capital will be needed, he said, to do the development work required, and there is room for many companies to take part in the huge and active program which has presented itself.

Leduc's rebel well, Atlantic No. 3, which started its wild career on March 8 with a blow-out involving a gas flow of 50 million cubic feet and more daily with oil forced over the derrick and surrounding countryside, has been killed at last. It was a spectacular and terrifying finish. Nothing remains but the wreckage.

As stated in a previous review, two directional wells were drilled, each about 700 feet from Atlantic, with the intention of tapping Atlantic's D3 zone from which the enormous gas pressures and oil to the extent of from 10,000 to 14,000 barrels daily were escaping. With this done, water was to be pumped through the directional wells in large volume to establish control so that the well could be killed.

As the work was nearing completion, Atlantic's derrick collapsed as a result of cratering. This took place early on September 6. It was expected, when the steel derrick crashed to the ground, that fire would follow immediately. But nothing happened. The workers had not long to wait, however, for the conflagration.

At 6:30 PM on the same day a ball of flame suddenly shot from the well head and started to spread over the surrounding territory. Flames found their way through the oil-soaked land, becoming immediately enlarged over the fissures through which oil was escaping.

The flame from the well head was estimated to be about eight hundred feet in height. The fire was reported visible from points over a hundred miles distant on land and as much as a thousand miles from the air. A smoke bank around fourteen thousand feet high covered a 25-mile area.

Bulldozers immediately went into action building retaining walls around the fifteen acres of flaming oil-soaked ground to prevent spread of the fire. The greatest part of the heat ferocity traveled vertically, enabling the workers to get this important protective work done. Surface operations to subdue the main blaze from the well were useless. The only hope was to pump vast quantities of water down the west relief well which had by then penetrated Atlantic's productive D3 zone a mile below the surface of

the ground. Acidization to increase the porosity and thereby enable an easier and greater flow of water into the zone was carried out at once and the water pumped in.

What started the fire will never be known. It is thought that a piece of rock hurled up by the terrific pressure might have hit the collapsed derrick and struck a spark, which was all that was necessary to start the tremendous flame. No one was injured despite the suddenness with which it all happened. Two workmen were 150 feet from the flame when it suddenly came into action and about 20 others were also close by, but all escaped. Ambulances were rushed to the field in case they might be needed, and the Alberta division of the Canadian Red Cross had units standing by, but fortunately their services were not required. All cars within a mile from the burning well were halted by the R.C.M.P., and later a road block was established at Nisku on the Calgary-Edmonton highway, and only those on official duty were allowed to enter the field.

No expert opinion could be obtained as to how long it might take to extinguish the fire. Perhaps a matter of days, perhaps months; it was impossible to say. The fight to control it must go on while $50,000 worth of oil and gas was being consumed by the inferno daily. It was a depressing outlook, and gloom settled on Alberta's oil industry. It was short-lived, however.

The battle was won at 2:40 AM on September 9, just two and one-half days after the fire had started. At this exact time the vast flame suddenly died down, flared up again three times and went out completely at 6:00 AM. The fighters had done a magnificent job, and the great Leduc field was saved from disaster.

A lot of work remained to be done. Pumping water through the west directional well was continued preparatory to cementing and closing off the drill hole. A vivid reminder of the desperate struggle with natural forces appeared in a great yawning crater filled with water and the wreckage of the derrick and drilling equipment valued at more than $100,000. A lot of work lay ahead to clean up the grim, chaotic scene, but there was satisfaction in the realization that the crisis was over and that Leduc's industrial future was preserved.

From the deliberations of the Fifth Annual Conference of Provincial Mines Ministers, held at Jasper Park, Alberta, during the first week of September, has come the appointment of a Continuing Inter-Provincial Petroleum and Natural Gas Committee. While oil and natural gas represent only two of Canada's natural resources, their importance has been increasing in recent years. With world shortage of oil as a result of ever-increasing demands of consumers now becoming particularly noticeable in the United States, it has become imperative that the Dominion of Canada should strive, as speedily and as efficiently as possible, to become self-supporting regarding her oil requirements.

Alberta for many years has produced 90 percent of Canada's oil. The scene is changing, however. Saskatchewan is stepping prominently into the picture. The Northwest Territories during the war demonstrated the productive capacity of Norman Wells. At vast expense and facing tremendous difficulties, the oil was transported by pipeline constructed through the hitherto unexplored Mackenzie Mountains to the Pacific coast, a distance of 500 miles over extremely rugged terrain.

As a peacetime operation this was considered economically unsound, so most of the wells were shut down to await the time when civilization approached more closely to the area. British Columbia, Manitoba and Quebec are now engaged in exploratory work for oil and gas. Ontario and New Brunswick, oil producers for many years, are continuing their activities. Canada has become oil conscious in the face of present needs.

The Continuing Inter-Provincial Committee is now in being to study matters pertaining to Canada's oil and gas reserves. It carries wide authority. The committee will have a representative from each of eight provinces together with four or five more from the oil and gas industry. A full-time paid secretary, whose salary will be borne by the provinces, will be appointed.

The committe's chairman is Ian N. McKinnon, the chairman of the Petroleum and Natural Gas Conservation Board. Government representatives are Dr. T. B. Williams, British Columbia; W. J. Bichan, Saskatchewan; J. S. Richards, Manitoba; A. R. Crozier, Ontario; Dr. I. W. Jones, Quebec; Dr. W. J. Wright, New Brunswick; M. G. Goudge, Nova Scotia. Representatives of the industry will be announced later by the Western Canada Petroleum Aassociation. Subject to the approval of the Mines Ministers, the paid secretary will be chosen by the Hon. N. E. Tanner, Minister of Lands and Mines of Alberta, and the committee.

The purpose of the committee will be to draft suggestions as to oil and gas regulations for guidance of provinces in the preparation of legislation dealing with such matters. Also it is intended that the committee should advise ministers on such matters as taxation, freight rates, supplies for development, distribution of oil, additional uses for oil and all matters related to the industry.

As a result of Canada's shortage of heavy oils outside of the surplus existing now in the prairie provinces, a special committee was appointed to assemble data for presentation to the Dominion and provincial governments for immediate consideration and action. Chairman of this committee is the Hon. J. H. Brocklebank, Minister of Mines and Natural Resources of Saskatchewan. Members include I. N. McKinnon, Alberta; Dr. T. B. Williams, British Columbia; and W. J. Bichan, Saskatchewan. Four or five representatives of the oil industry will be appointed by the Continuing Committee.

Recommendation to the ministers for the appointment of the Continuing Committee and Special Committee was made by a sub-committee headed by J. G. Spratt, Anglo Canadian Oil Company. Members of the sub-committee included three government representatives: Dr. J. F. Walker, British Columbia; C. A. L. Hogg, Saskatchewan; and Dr. W. J. Bright, New Brunswick. Representatives of the oil industry on this committee were C. T. R. Wilson, New Brunswick Oil and Gas; C. F. Schock, Stanolind Oil and Gas; G. H. Bevel, Canadian Gulf Oil; A. G. Bailey, Husky Oil and Refining; and C. S. Robinson, Calgary and Edmonton Corporation.

The subcommittee met during the conference to consider a brief of the Western Canada Petroleum Association which was presented by John O. Galloway, vice president of the WCPA and head of California Standard Company's activities in western Canada. The brief presented an eleven-point program which included an agreement among the provinces and between them and the Dominion government as to a national oil policy; standardization of regulations to encourage efficient development and promote healthy competition; establishment of a sound

Oil flow from craters of Leduc's rebel well. This Alberta government photograph was snapped shortly before the well burst into flames.

tax policy and fair royalties; utilization of natural gas and provincial support in obtaining outlets for surplus heavy crudes now being produced in Saskatchewan and Alberta.

Just before the presentation of this brief, Mr. Tanner, Alberta's Minister of Lands and Mines, had stated that the Alberta government favored the export of a part of the provinces' gas reserves, provided reserves are adequate for domestic and industrial needs in the province and a surplus is available. He referred to gas fields being discovered in areas where oil was sought, to the fact that no large market for gas existed in Alberta at present, domestic and industrial needs already being served, and to the fact that export to other provinces or to the United States would stand as a market for new discoveries, bringing revenue to industry and government alike. He concluded his remarks by stating, "I am confident that we shall find greater reserves of natural gas almost monthly."

The prospective new wet gas field at Hanna is at present very much in the news. Perforation of the well's casing in this area has resulted in a gas flow exceeding 20,000,000 cubic feet per day. at around 3,800 feet in the Kevin Sunburst sand. Tests for distillate content indicate a possible recovery of 1,000 barrels per day of 66° gravity distillate. An allowable of 200 barrels daily is probable. This new area, east of Drumheller, may introduce another Turner Valley with high-priced distillate oil. The probable price on present markets is estimated at $5. per barrel. In company with Pincher Creek in the south and Redwater in the north, these three prospective Alberta oil fields, together with the already-established major fields of Leduc, Turner Valley and Lloydminster, may add enormously to production totals of Alberta. In other words, they may bring Canada very much closer to the desired goal of petroleum independence.

Atlantic No. 3 after the derrick collapsed and the well caught fire. ↓

PURE OIL'S NEW CRACKING UNIT

PROTECTING its competitive position in the geographical center of the rich Ohio market, The Pure Oil Company has installed a new 5,000-barrel Fluid cat cracker at its Heath refinery located some 35 miles east of Columbus. The plant is about midway between the company's refineries in Toledo, Ohio, and Cabin Creek, West Virginia, and in another direction midway between competitive refining centers at Cleveland and Cincinnati. The location thus gives an advantage in central Ohio to the company which now is being reinforced by the flexibility in yields and quality which the modern catalytic cracking plant provides.

In the six years since the first Fluid cat carcker was put on stream at Baton Rouge, La., refinery of Esso Standard Oil Company, a great deal has been learned by the operators and designers of fluid units. By building its Heath unit at this time, Pure Oil Company was able to have all of the improvements dictated by more than thirty predecessors built into its new unit. Principal results will be longer periods on stream, increased efficiency while operating, and shorter shutdown time between runs. Designer and builder of the plant was The M. W. Kellogg Company, builder of the first Fluid cat cracker and of more than twenty-five others.

An important element in reducing both first cost and operating cost of the new Pure unit is the recent change in design which has substantially lowered overall height of units, the new Pure unit being the lowest in height ever built by Kellogg. The unit is 65 feet high to the regenerator level, compared with some 120 feet for earlier down-flow Fluid units. Early wartime plants were designed with excess height to provide an added safety factor to make sure that the catalyst would move freely and efficiently from vessel to vessel as required, without the addition of mechanical energy. There are three elements involved in every flow: operating pressure of the vessel from which the catalyst is moving, hydrostatic pressure of the catalyst bed, and hydrostatic pressure of catalyst in the standpipe. Opposing such movements are the pressure drop in transfer lines, operating pressure of the vessel to which the catalyst is being moved, and hydrostatic head of catalyst in this vessel. It is obvious from the above outline that the mathematics get quite complicated and the elevations have to be worked out with care as well as with an adequate background of experience.

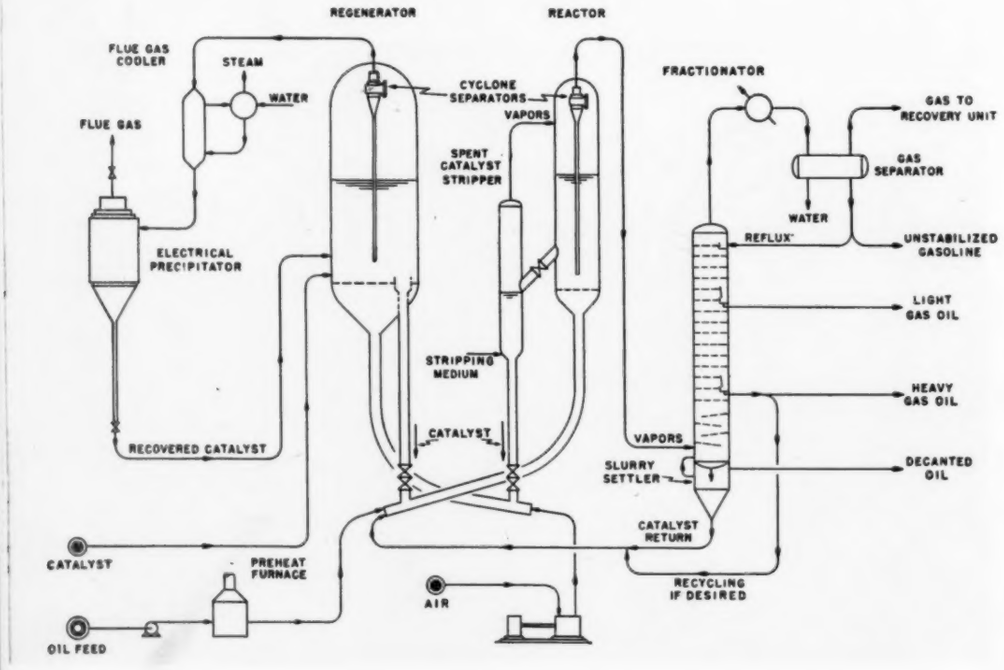
By balancing pressures of the reactor and regenerator at a low value and by keeping them substantially the same, it has been possible to design the more recent Fluid units, such as this Pure cracker, so that reactor and regenerator are supported at the same platform level. This reduces overall height and simplifies operation and maintenance.

A separate spent catalyst stripper has been incorporated in the Pure unit. It is the second of its sort to be built. Previously the stripper was incorporated in the reactor. With the new arrangement spent catalyst with its burden of carbon is withdrawn continuously from a point near the base of the reactor to the stripper, where hydrocarbon vapors are separated from the catalyst by steam and returned to the top of the reactor. The spent catalyst then moves to the regenerator without carrying any useful hydrocarbon vapors to the burning area where they would be wasted.

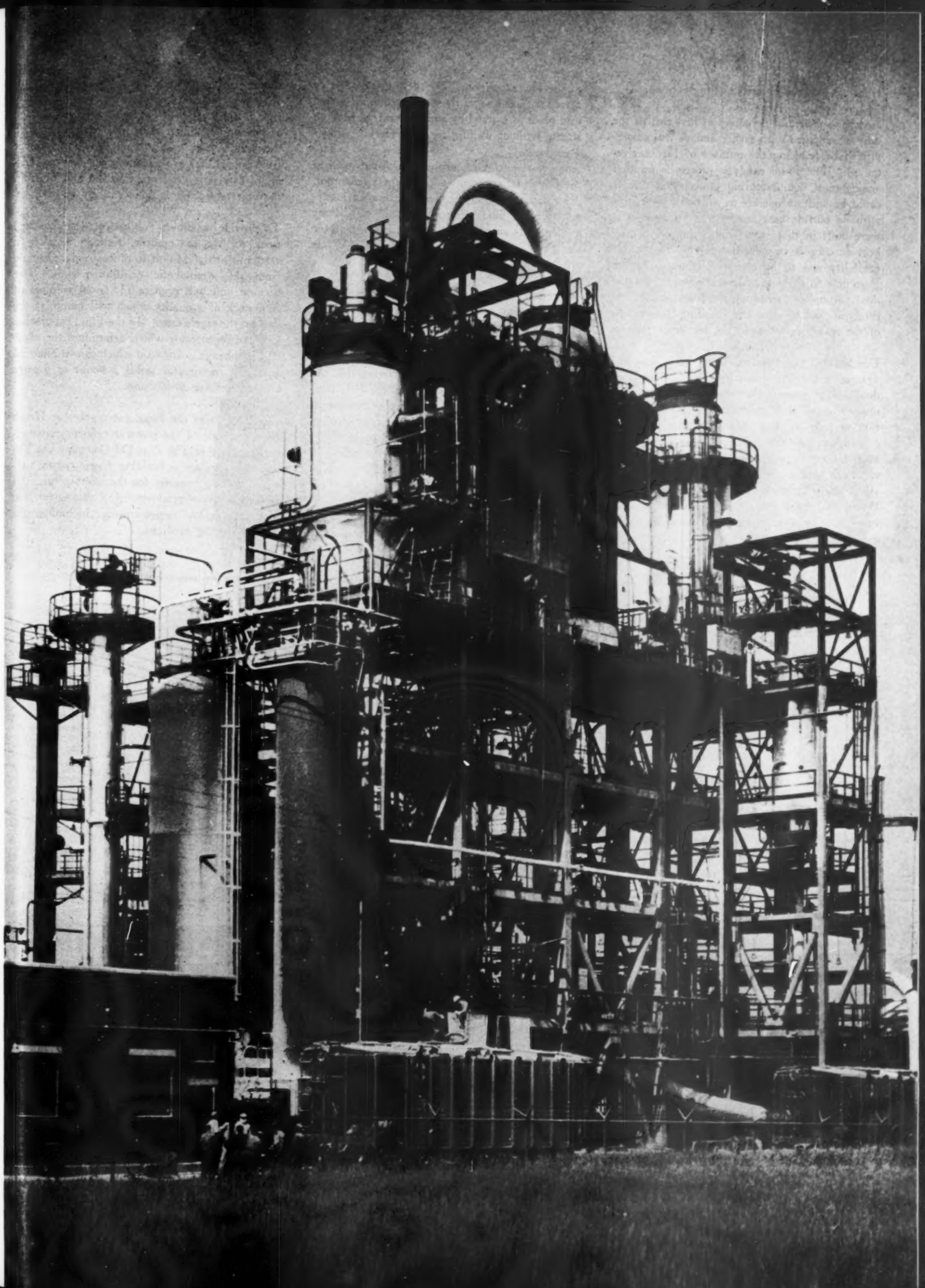
In the old method where steam was introduced into the stripper, which was an integral part of the reaction zone, short-circuiting was possible. The stripping steam now does not pass through the catalyst bed in the reactor but is returned to the vapor space at the top, together with stripped hydrocarbons, and is handled with reaction products in the subsequent fractionating step. Adsorbed and entrained hydrocarbons in the spent catalyst are more completely removed before burning, and the net result is a greater yield and higher unit throughput for equal vessel capacity. The higher throughput capacity is largely attributed to the reduced load on the regenerator.

The safety of the slurry settling operation is improved, and initial cost of the slurry settler has been reduced by incorporating the unit in a compartment in the base of the fractionator. Pipe, valves and structural steel requirements have been reduced without loss of efficiency in the separation of catalyst from heavy oil before withdrawal

Flow diagram of Heath unit.



Catalyst being unloaded directly from railroad cars into Pure Oil Company's new 5,000-barrel Fluid unit at Heath, Ohio →



from the base of the fractionating column.

Another substantial reduction in first cost of the unit as compared with earlier designs was accomplished by reducing the number of furnaces required. The Fluid catalytic process is unusual among most manufacturing processes in that it could be built to operate as a heat balance unit with no outside heat required. Wartime units were built in that way. Since the war a preheat furnace is considered desirable to provide flexibility and to increase throughput. In the Pure unit only one furnace was provided for the dual purpose of preheating the fresh feed to the catalytic cracking zone and reboiling the bottoms of the stabilizer tower in the recovery system.

Unscheduled shut-downs have been guarded against in the Pure unit by the installation of double slide valves in the catalyst standpipes. The upper slide valve is maintained in the open position as long as there is no difficulty with the one in use. If the operating valve should fail to function for any reason, the upper stand-by valve can be brought into play. The unit is provided with a third valve in the parts stock. When the unit is brought down, the lower slide valve will be unbolted and removed for subsequent reconditioning, and the upper valve moved to the lower position. The new third valve or a reconditioned valve then can be quickly bolted into place as a stand-by and the unit go back on stream without waiting for shop work.

Another recent design change which was used in the Ohio plant was the adoption of a leakproof, prefabricated cylindrical shell for the electric precipitator for final recovery of catalyst. In the earlier units an oblong, field-erected precipitator shell was used which was heavier and still was not as leakproof as the cylindrical unit.

All vessels in the Pure unit with the exception of the regenerator were shop fabricated and shipped complete to the job site. Maximum diameter of piping employed was 24 inches.

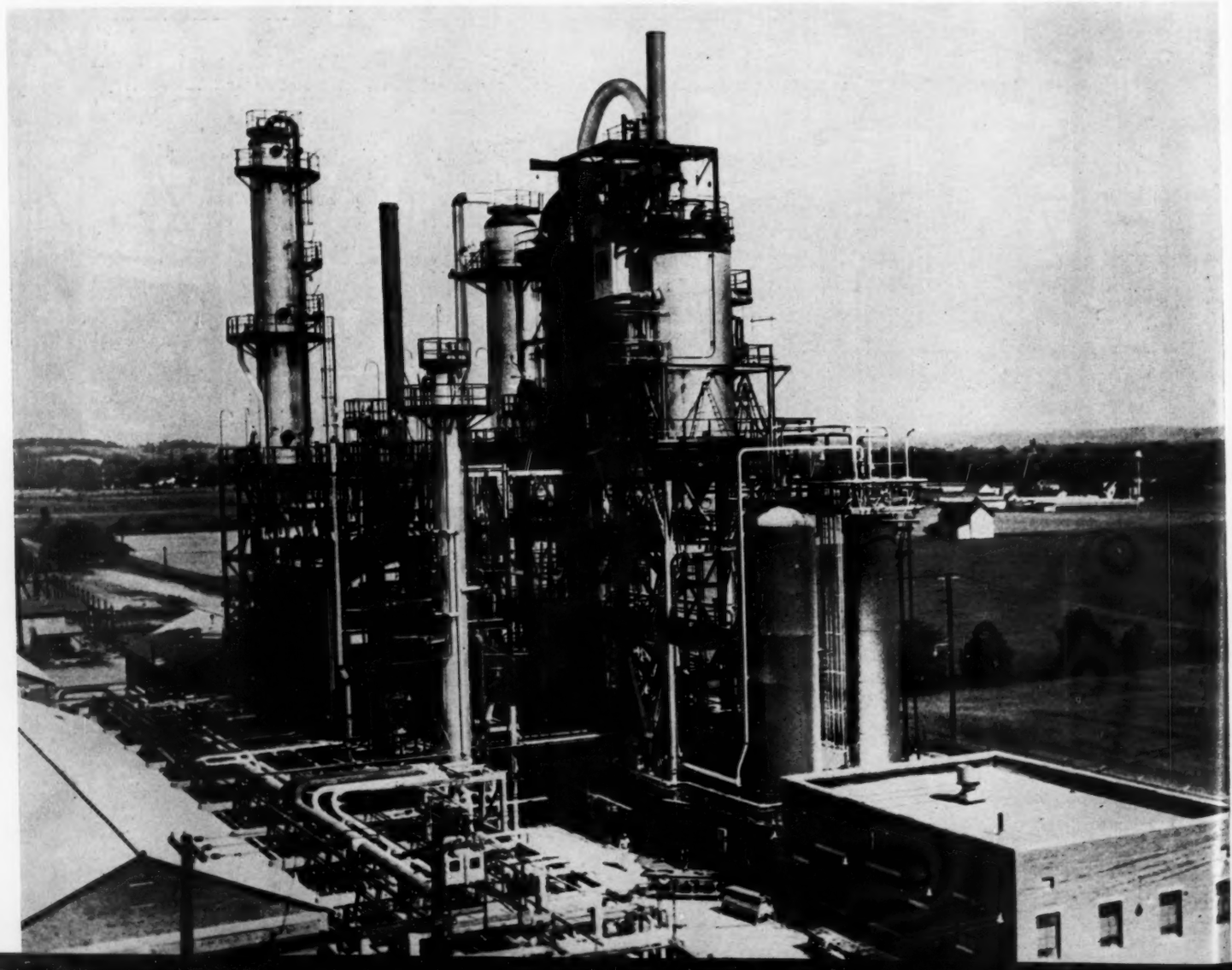
As shown in the accompanying photograph, the Pure unit is built in two main, parallel lines. The reactor, regenerator and precipitator are in one line. In the second line are the fractionating column, gas recovery equipment and preheat furnace. This design contributed to the ease and speed of erection and will permit easy and economical maintenance.

Two catalyst drums are provided for storing catalyst in the plant. The larger of the two hoppers shown in the photograph can hold the entire inventory of catalyst contained in the unit at any time. The smaller of the two is used for storage of make-up catalyst. A railroad spur extends to the unit so that catalyst may be blown direct from hopper cars to the storage hoppers. Transfer of catalyst from storage to the unit or from the unit to storage is done entirely by air.

To provide maximum volumes of desirable feed stock for the cat cracker, Kellogg installed a vacuum distillation unit to process reduced crude from the atmospheric distillation unit. The vacuum unit will prepare additional volumes of feed stock of a quality which will minimize the load on the regenerator. In the Fluid cat cracker it is the regenerator which determines the capacity of the unit. Any load which can be removed from the regenerator yields a bonus of greater cracked gasoline production.

Construction of the Fluid cat cracker at Heath is only a part of the postwar refinery construction program of The Pure Oil Company. At Toledo the company is building a new coking unit and installing facilities for the manufacture and storage of special products. At Cabin Creek it is making various improvements including increased loading facilities.

Pure's Fluid catalytic cracking unit is laid out in two parallel lines. Fractionating columns, gas recovery equipment and preheat furnace are in one line and reactor, regenerator and precipitator in the other line.



OIL . . . today and tomorrow

By Frank W. Abrams

In an informal talk before the American Chamber of Commerce in London, Frank W. Abrams, chairman of the board of Standard Oil Company (N.J.), presented a striking picture of the world oil situation today and the oil industry's obligation for the future. In view of the fundamental importance of the address, WORLD PETROLEUM takes pleasure in publishing it complete, aside from the speaker's brief introductory remarks.—Editor.

IF the physical and material needs of the world are to be met, basic energy resources must be sharply increased. No one, I think, would deny that the world's productiveness must be expanded at an unparalleled rate if we are to provide for the growing needs of people everywhere. But it is sometimes overlooked that energy—energy in all forms—is basic to this task.

In our modern civilization, petroleum means energy. To find it, to get it out of the ground, to process it and to deliver it is our job—one which demands all the technical skill, enterprise and statesmanship of industry.

World need for oil has never been greater. Furthermore, demand is mounting steadily, and its ultimate peak cannot be foreseen. In the demand picture the needs of the nations recovering from the war and reestablishing their economies and standards of living are emphasized. Oil is, therefore, a subject of world interest—to those who need it, to those who produce it and to those in government and civic life who are anxious to keep the machinery of world recovery fueled and lubricated.

Certain considerations seriously affect the oil situation now and will influence it significantly throughout the years to come. The first and most important consideration is that the patterns of oil supply and distribution are changing more rapidly today than they have at any time during the industry's century of history.

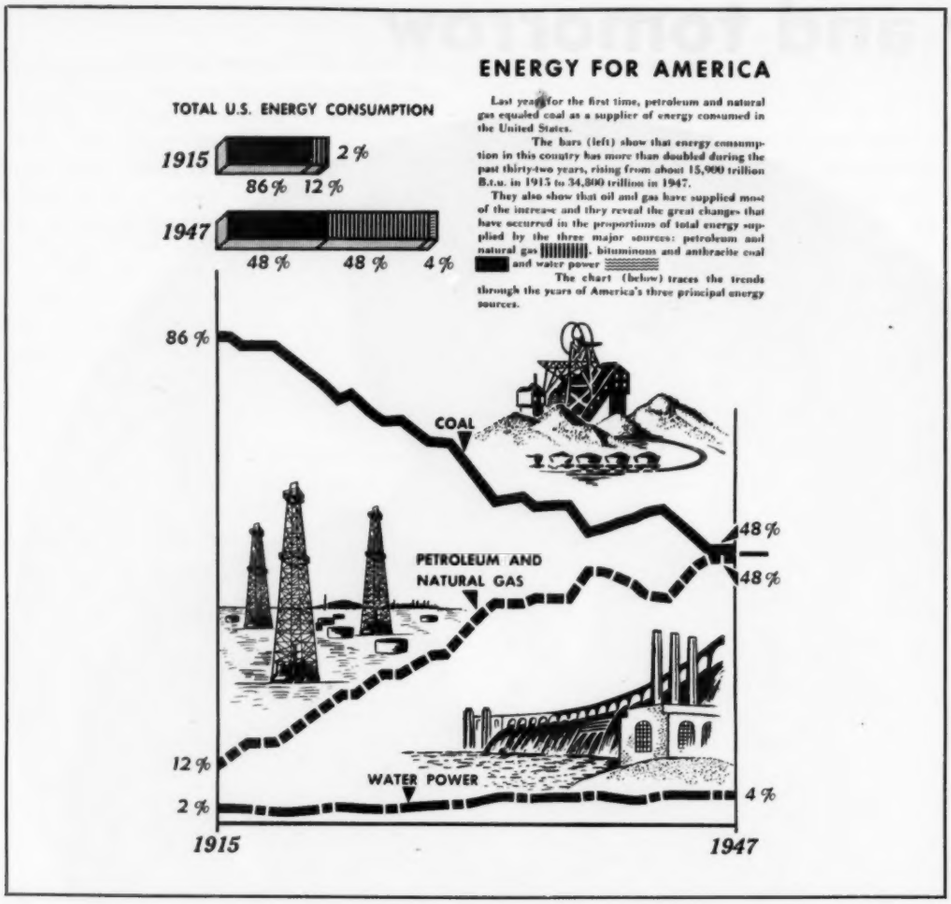
In the world oil picture as many of us have been accustomed to view it, the United States has long been regarded as the chief provider of petroleum products. During recent years we have watched the outward flow from our country diminish, and this year we saw it reversed. More oil is now coming into the United States than is flowing out. From a net exporter of oil, our country has become a new importer. During the first five months of this year our net imports were in excess of 130,00 barrels a day.

All the major industrial nations of the world are now dependent on sources outside their frontiers for at least a part of their oil supply. This fact focuses attention on the need for United States, requiring new developments, new industries and new distributive systems.

The day has passed when we could think of oil in terms of single countries. We must now, of necessity, think in world terms. For the major industrial nations today can secure their own oil supplies only by actively cooperating with other nations in solving the supply problems of the world.

Statistics are usually dry and hard to remember, but I don't know how to present the world oil situation facing us today without calling attention to a few important figures.

From a present level of 9½ million barrels daily, oil production must reach 12 million barrels daily in 1952 to meet the expected increase in the world's consumption. This latter figure is based on the best working estimates that oil economists can make from the data now available. In the next four years the industry must find new oil and develop known reserves so that 2½ million barrels daily can be added to present production. Not only must this increment in production be achieved, but the crude oil


ENERGY FOR AMERICA
TOTAL U.S. ENERGY CONSUMPTION
1915
2 %
86 % 12 %
1947
48 %
48 %
4 %
Last year for the first time, petroleum and natural gas equaled coal as a supplier of energy consumed in the United States.
The bars (left) show that energy consumption in this country has more than doubled during the past thirty-two years, rising from about 15,900 trillion B.t.u. in 1915 to 34,800 trillion in 1947.
They also show that oil and gas have supplied most of the increase and they reveal the great changes that have occurred in the proportions of total energy supplied by the three major sources: petroleum and natural gas, bituminous and anthracite coal and water power.
The chart (below) traces the trends through the years of America's three principal energy sources.
86 %
COAL
48 %
PETROLEUM AND NATURAL GAS
48 %
12 %
WATER POWER
4 %
2 %
1915
1947

must be refined and the products delivered wherever they are needed throughout the world.

The job to be done is one of gigantic proportions. It calls for big outputs of energy, money, and knowledge. It calls for finding new oil sources, drilling new wells, and building new refineries, pipe lines, tankers and all the other things it takes to provide people with the oil products they need.

The oil industry of the world is facing the job job with the utmost determination, and is in the midst of the greatest expansion program in its history. New facilities alone will require estimated capital expenditures equivalent to 13 thousand million dollars during the five years, 1947-1951. No other industry, to my knowledge, has ever embarked on a program of such proportions.

Considering the extent both of oil requirements and of the industry's expansion program, it is logical to ask whether raw material exists in sufficient volume to meet these requirements and to justify this expansion. The answer is, "Yes." We know there is enough crude oil in the earth, found and yet to be found, to satisfy the demand for liquid fuels for many decades, perhaps even for centuries. We also know that when the natural supply of crude oil begins to fall short, we can make liquid fuel from natural gas, coal and oil shales. Estimates made by government and industry experts of ultimately recoverable mineral fuel—that is, petroleum and oil from shale, tar sands, natural gas and coal—range upward to quantities that would be sufficient for more than a thousand years at the 1947 rate of consumption.

The problem before the world suppliers of liquid fuel is not one of limited natural resources. Rather, it is one of developing those resources on a sufficiently broad basis so that production can expand as rapidly as demand increases, and products can be distributed in adequate quantities wherever they are needed.

This brings me to the second consideration I should like to mention. The Eastern Hemisphere can no longer rely on the Western Hemisphere for the bulk of its oil. Its own resources must be developed promptly and extensively.

Let us look for a moment at the world in terms of geography and oil. With 45 percent of the world's proved oil reserves, the Western Hemisphere has accounted for 79 percent of the world's oil production to date. On the other hand, the Eastern Hemisphere, with an estimated 55 percent of the proved reserves of petroleum, has produced up to now only 21 percent of the world's oil. It is apparent that as this immense sector of the world increases its industrial capacity and works toward ever higher standards of living, vast additional sources of oil must be sought out and developed.

The United States oil industry, as its part of a world-wide effort, is engaged in the greatest oil expansion activity in its history. Production in the United States of all types of petroleum is now averaging six million barrels a day, and has increased by about 400,000 barrels a day during the past twelve months. But consumption in the United States and throughout the Western Hemisphere is growing so rapidly that marginal supplies to meet mounting requirements abroad are bound to become increasingly difficult to find.

Prodigious steps are already being taken to expand oil production throughout the world. Venezuela has increased its rate of production by 160,000 barrels a day during the past twelve months and is now producing about one and one-third million barrels a day. On long range programs, new areas are being explored from southwestern Venezuela down through Colombia, Ecuador, Peru and Argentina, to the extreme tip of South America. Canada's new field in Alberta is a welcome addition to the production picture. Exploration is going on in different parts of Western Europe, and even—according to vague and unsubstantiated rumors—in parts of the Soviet Union. There are some prospects for future development along the North African coast from Morocco to Egypt. India will certainly expand its present production, and further possibilities exist in Indonesia. Of course, the largest and certainly the best known oil development activities are those in the Middle East.

This leads to a third consideration of major importance. The rate at which the economies of Western European nations can expand will depend in large degree on how vigorously and rapidly Middle East oil can be developed.

The Middle Eastern fields contain the most economic source of supply available to Western Europe today, and more important, they contain the only presently available large reserves which can be developed in time to meet Europe's needs. That is why the interest and efforts of much of the oil industry are concentrated to such on extent on Middle East oil.

Oil in quantities far above supplies presently available to Western Europe is one of the important requirements that will have to be met under the Marshall Plan. In the Plan, oil occupies second place, being surpassed only by food. We know that as Europe again assumes its rightful place in the world of business and commerce, there will be productiveness at higher levels than ever before, requiring a decided increase in the use of machines for the production of food, goods and services.

Oil consumption of the sixteen Marshall Plan nations this year amounts to about 900,000 barrels per day, an increase of nearly 50 percent over the 1938 consumption figure for these same nations. This total will grow to about one and one-quarter million barrels per day by 1952. A major part of the oil supplied Western Europe this year under the Marshall Plan will come from the Western Hemisphere, despite the pressure of its own local demand. But it is estimated that by 1952 about 65 percent of Europe's total requirements will come from the Middle East.

Many challenging economic and geographical factors are involved in production and distribution from the great oil basin of the Middle East. One that I should like to mention particularly concerns distance. The haul from terminals on the Persian Gulf to the French southern ports is 4,500 miles, and 6,000 miles to the Channel ports. The sea route from the Persian Gulf to Western Europe is expensive, but it is feasible as long as the demand can be kept within the available tanker capacity. Tankers far in excess of tonnage now available would be needed, however, to handle the greatly increased supplies which we hope will be flowing from the Middle East within the next few years. Facilities must, therefore, be planned and built to take care of a major transportation situation.

To transport oil by tanker from the Persian Gulf to the Mediterranean requires more steel, more manpower, more expensive equipment, and higher operating costs than to move the same volume by pipeline. Therefore, several oil companies operating in the Middle East are considering giant pipelines to the Mediterranean, so that up to 3,200 miles can be cut off the transportation route and oil can be brought to Europe in the quantities needed. Six major lines ranging in diameter from 16 to 36 inches are now either contemplated or actually under construction.

When these pipeline projects are completed, it will be possible to transport almost two million barrels per day of Middle East crude oil to eastern Mediterranean terminals, from which tankers can make the shorter haul to European ports. I doubt whether the oil industry has ever before concentrated so much effort and investment in so short a time and in one area to meet the needs of its customers; in this case, the industries and people of Europe and the British Isles.

At the present time the completion of these lines is being retarded by a number of factors, important among them being material shortages. Pipe of the dimensions needed for these new lines requires a considerable amount of steel. Steel is one of the critical materials needed in every country's program of economic recovery, and world demand for steel is still running well ahead of production.

In steel we have another measure of economic interdependence in the modern world. The crying need for this vital material can be alleviated only through a general increase in steel production throughout the world. We are all hopeful that ways can soon be found to raise the steel-making capacity of many countries and particularly of Europe.

Production and transport of crude oil are vital phases in the world oil economy, but before the oil can be used, it must be refined into products adapted to the needs of the people. Therefore, the expansion of refining capacity for handling increased production is another large item in the oil industry program.

The oil industry has foreseen the need for increased facilities to process Western Europe's oil at the point of use, and the dollar exchange requirements to carry out these projects are taken into account in the Marshall Plan. Having a refining industry within their own borders to take care of their requirements conforms with an understandable desire on the part of nations. But economic and practical considerations are also important, among them the relative advantages of single large-capacity installations as against smaller units. For these reasons a substantial proportion of the Middle East crude will continue to be refined at the point of production or at the end of the pipelines carrying it to the Mediterranean.

A number of major refineries undoubtedly will rise during the next few years near the large consumption centers of Europe. Anglo-American Oil Company already has announced plans for a considerable enlargement of its refining facilities in the United Kingdom. These plans call for the construction at Fawley of a plant which will handle approximately 128,000 barrels of crude oil per day. All the details have not yet been completed, but preliminary work is already being undertaken on this project on the assumption that discussions with local and government authorities will lead to satisfactory agreement. This program for increased refining facilities in the United Kingdom will result in most important savings in dollar exchange.

During the war the refineries in Continental Europe suffered severely, and since 1945 a program of rehabilitation has been under way. The refineries of Standard Oil (New Jersey) affiliates in Denmark, Belgium, France, and Italy have all been returned to at least their prewar capacities. The refinery in Germany is rapidly approaching its capacity, and steps are being taken to restore refining facilities in Norway. Without being wholly conversant with the progress made by other companies, I am confident that they too are doing their utmost to restore their war-damaged plants in Western Europe.

The foundations of expanded production, transportation, and refining to meet the growing needs of the Eastern Hemisphere have been laid. But progress toward realization of this expansion program has been retarded by political consideration, the adjustment of which lies far outside the orbit of the oil industry. In recognition of these considerations, I should like to make a few points clear:

(1) Development of Middle East oil and the facilities to handle it are essential to the well-being and progress of the nations in the Eastern Hemisphere.

(2) The oil industry of the peace-loving countries is making an all-out effort, industrially and financially, to expand Middle East production.

(3) Middle Eastern oil resources are not counted upon in the immediate years ahead to supply any significant part of the American market. They will have a very great effect on the American oil picture, however, since their availability will reduce the necessity for the present large exports of oil from the Western Hemisphere.

(4) The interests of the companies engaged in producing Middle Eastern oil are not political. They are based on peacetime commercial needs.

The whole subject of Middle East oil is today attracting world attention. It is natural that a development of such vital concern to many nations should hold wide interest. Unfortunately, it has also become a major political isue. Quirkish geography has placed oil beneath some of the lands which today are centers of political and social unrest. Various means have been used to cast doubt on the integrity and intentions of the oil companies operating in these troubled areas.

Efforts have been made to align one group or interest against another and to sow the seeds of distrust. Propagandists are trying to turn the people against Western European and American enterprise in the Middle East.

I have no doubt that the expansion program of the oil industry will continue to go forward, despite temporary obstacles and difficulties, because peace-loving people everywhere realize that increased productivity in the world can be one of the surest steps toward enduring peace. By doing its utmost to make the Europe Recovery Program successful, and by pursuing its own program of world-wide development in order to bring to the people of the world the fuel so urgently needed, the oil industry can help importantly to bring this high ideal closer.

Men down the ages, when faced with mighty questions, have produced mighty answers. And I should like to suggest that the great challenge is not only to the technological skill of the oil industry. The challenge, both inside and outside the industry, is to our vision and statesmanship. It seems to me that the great need today is to progress quickly, efficiently, and honestly in a world of conflicting hopes and interests. But I assert again that it can be done.

I do not underestimate the magnitude of what is being required of us, of what we all hope to accomplish. The economic tasks alone are tremendous and will require all the energy, initiative, and enterprise that can be assembled across the face of the globe.

Material ends, however, are not in themselves enough. The great decisions of history, it has been said, are always moral. I think that the moral challenge before all of us today is great enough to insure great achievements.

The peace of the world today can best be promoted and sustained through the building of trust and confidence between people. Surely the opportunity lies before us to cooperate toward this end in the production of needed goods for all and through honorable dealings between the peoples of the world.

OIL SUPPLY FOR NATIONAL SECURITY

By Joseph Huttlinger

Washington

FACED with the duty of being ready for any emergency, up to and including war, military and government planners are giving top attention to petroleum. Some of the latest ideas churning in their heads have taken form in the staff report on oil at the National Security Resources Board.

This is a Big Bertha. It embraces far more than a proposed 15 to 20 percent set aside in domestic crude production in order to build up a reserve of oil for use only in an emergency. The report still is confidential but is being shown to a few in the industry for their comments. Only one of several studies under way, it is perhaps the most important to be completed since the close of the war.

In its main substance the staff report calls for vastly increased imports to meet normal, peacetime needs. It would increase worldwide exploration for oil, and the search in the western hemisphere would go on as long as new supplies continued to be found. It would employ coal instead of oil in heating and power uses wherever economical. It would touch off a decade-long effort to set up a synthetic liquid fuels industry. It would send steel and other critical materials to the oil and natural gas industries in far greater volume and at once. It would welcome higher prices for crude petroleum and products. It would invoke, in a war, a rationing to reduce civilian supplies by 20 percent.

The Board, of which Arthur M. Hill is chairman, makes no secret that it considers the oil industry perhaps the key to success in any war. And to the oil industry perhaps more than any other are these words applicable:

"The mobilization of the country for war would be immensely more difficult under present circumstances than in World War II. . . . In 1939 and even in 1941 the country had a great volume of unemployed industrial and human resources. . . . At present the economy is fully loaded and, therefore, the diversion of agricultural and industrial capacity to war purposes would require a drastic decrease in the level of consumption."

These are the words of R. E. Gillmor, vice chairman of NSRB.

The present report is by no means considered a complete or definitive job. Projects of potential usefulness in combatting a wartime oil shortage are left out. For instance, such World War II proposals as sending portable refineries to the Dutch East Indies and erection of oil shale plants in Australia come in for little attention,

Arthur M. Hill

although these are by no means visionary in comparison with many ideas for America's oil security being talked of as the long-range aspect gets a thorough going over by military, government and industry committees.

Far broader than the NSRB staff report is the full scope of thinking about petroleum for another war. What about South America, for instance? Should the State Department be permitted to piddle along while a definite program of hemisphere development for hemisphere security remains merely a subject for conversation? What about allocations of materials in the event of a war? Who's going to equate the needs of various users for steel, petroleum and the variety of materials that become critical in a war? Do pipelines do the job better than tankers, and in what parts of the world and for what purposes? Or should we have an in-between course? How about additional avgas capacity? How about additional jet fuel capacity? And what about military stockpiles?

The NSRB staff report doesn't answer these questions, but other studies are relied upon for proposals as to some of them. The National Petroleum Council has several committees at work on industry problems. One is looking at current steel needs, another at manpower needs, and a third at a National Oil Policy. The NPC's Committee on National Emergency is studying measures "to safeguard and assure supplies for essential needs in times of emergency." The chairman is B. Brewster Jennings, president of Socony-Vacuum Oil Company.

The American Petroleum Institute has its Defense Services Committee on the job. This may bring forth a plan basically acceptable to the oil industry. The chairman is C. E. Cummings of The Texas Company. The Military Petroleum Advisory Committee set up by the Interior Department to obtain the advice of outstanding industry experts is studying ways of assisting the government to find the oil needed for another war. The chairman is Bruce K. Brown, vice president, Standard Oil Company (Indiana). The Armed Services Petroleum Board is at work. And Interior's Oil and Gas Division, under its respected and retiring director, Max Ball, is lending its advice to the numerous government agencies concerning themselves with the problem.

What's it all about? For one thing, it is a matter of relations with Congress. Several pontifical members of that body have demanded assurances that, one, the oil industry shall be able to meet civilian peacetime demands; and, two, that it shall satisfy current military needs and be able to meet the huge oil needs of another war, if and when it comes. If the Congress fails to get these assurances, it is likely to try to pass some laws on the subject. In the light of some past proposals originating on the Hill, this raises the possibility that legislation might hurt rather than help oil development. One action Congress could take to help matters is to clear up for all time the title to ownership of the tidelands.

From whatever angle it is viewed, the job of oiling another world war is a tremendous one. A top-ranking Air Force officer told Congress that "it's extremely doubtful that our requirements for jet fuel of present specifications can be met in the event of a war." A high Naval officer said flatly that we do not have the oil for another war. A top Army general said, "Petroleum is the most critical logistic matter in our security."

These are fighting words to confident oil men. They politely point out that the oil industry has never let down the nation in time of war or peace; that its whole record is one of finding oil when the experts said there was little to be had. Men such as B. A. Hardey regularly challenge the pessimists with the record of the oil industry. This past president of the Independent Petroleum Association of America, who is a director of the American Petroleum Institute, believes that given the steel and the tools, the domestic industry will build up a productive capacity that will be able to take care of any emergency.

But other executives admit there is a problem. Thus Bruce K. Brown frankly states that "the possible supply problem in another war staggers the imagination." The tightest spots will be avgas and jet fuels, where, he said, "we see

difficulty ahead." And Dr. Eugene Ayres, research director, Gulf Oil Corporation, wants "maximum imports" in time of peace on the theory that each barrel imported saves a barrel of domestic crude for later use. Thus, in industry as well as in government, there are conflicting views.

How much oil for a next war? Defense Secretary James Forrestal estimates 2,750,000 barrels per day for the military alone, twice the amount used in the past war. No substantial report has disputed the estimate. With civilian requirements rising steadily, the Secretary explained, "It appears now that the United States military and civilian needs for a major war effort would exceed by at least 2,000,000 barrels per day the predictable production from the continental United States." Assuming these figures, the NSRB staff report comes up with the first attempt at an over-all program of industry-government relations to get more oil for an emergency.

As an encouragement to greater production the report comes out for higher prices. It is imperative to accord to the industry a generous price for crude oil and to continue in effect existing tax laws and regulations which encourage expenditures for exploration and development, it flatly asserts.

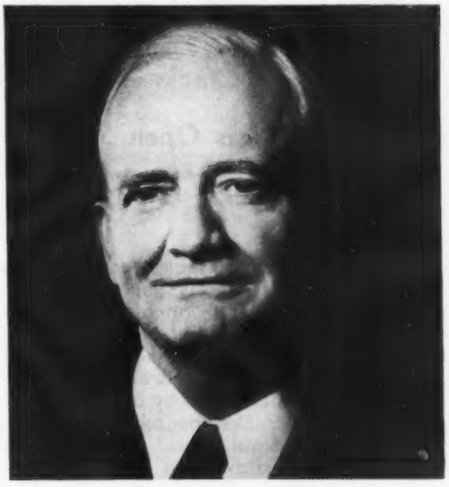
The higher prices level would permit domestic crude producers, with less economic pain, to observe the report's cardinal aim of reducing output. It would encourage drilling for new reserves at home and abroad, a chief recommendation in the document. It would encourage the use of coal for home and factory heating and power, something the report asks wherever economical. It would aid the drive toward oil conservation and advance the date by which a synthetic oil industry would become commercially feasible.

The wording of the proposed domestic crude production set-aside calls for pegging domestic production at one million barrels a day below the maximum efficient rate. Right now production is hard against the maximum in most fields. Total production is about 6,600,000 barrels a day. Thus, the recommended slash amounts to about one-fifth. This would leave the nation with the same approximate unused capacity it had at the start of World War II.

In the event of war the staff report would reduce civilian supplies by about 20 percent. This would save an estimated one million barrels a day for the military. It would be about twice as strict as the last war's rationing which reduced civilian supplies only 10 percent according to the report.

On the overall problem, the report suggests "far more" reliance upon the resources of the eastern hemisphere to meet world demands for petroleum. The overall reserves of the earth, as yet but superficially explored, should be developed and made readily available to all nations, it asserts. Many more tankers should be built to move foreign oil to the United States.

Continuing, the report asks that the resources of North and South America be developed to meet military and civilian demands which, it declares, they can do for many years to come. But imports of petroleum must be so controlled as to protect and stimulate domestic operations, the report adds.



Wallace E. Pratt

In the future when petroleum in the "minimum strategic defense area" is inadequate, the nation should get liquid fuels from oil shale and coal on what the staff report calls a "competitive" basis. But the synthetic industry should come only by "gradual establishment" over a decade or so. A vigorous domestic liquid fuels industry, says the document, is the prime essential of national security, whether it uses petroleum or other liquid hydrocarbons as raw materials.

For the next three years the report suggests maximum diversion of critical materials and manpower to the petroleum industry; industry gives this a hearty welcome. It proposes efficient use of these materials and men. The third proposal for the immediate future would bring about maximum substitution of other fuels, coal and natural gas, for oil in heating and power-generating plants.

On conservation and end use, the document asks a continuing, marked decrease over the next decade in the use of residual fuel oil for heating and industrial purposes and the substitution for it of coal, gas made from coal and natural gas. Also over the decade, the report expresses a desire for practically complete replacement of coal and residual fuel in railway locomotives by diesel motor fuels, which have demonstrated their superior efficiency and enonomy.* Under steam boilers, it points out, oil is little more efficient than coal. In diesel motors it is six times as efficient as coal burned under steam boilers.

The residual oils saved by the conservation and end use control would be further cracked into lighter oils under the program. Many refineries are being and others can be fitted to do this cracking job. With adequate steel, natural gas pipelines would be greatly extended in the immediate future and would serve important markets that they do not reach at present, reducing the use of oil for heating purposes.

As envisioned by the report, petroleum, in another fifteen years, would be restricted to use in internal-combustion engines, which will have greatly increased efficiency, and in diesel locomotives. A synthetic industry would be in production, but it would add little to home heating supplies, for the report says its products would be too expensive to use for this purpose.

The NSRB staff report is the first attempt recently at an overall program to assure supplies to the military in the event of war. A chance to suggest changes is being offered a few in the industry. Copies of the report are in the hands of Chairman A. Jacobsen and other members of the National Petroleum Council's Committee on National Policy. It has been put before interested government officials in Washington.

The Board will consider and may accept some changes that may be offered before it officially stamps the document as approved and sends it to the White House for such further action as may be deemed advisable. The preliminary report was prepared under direction of Wallace Pratt, well-known authority on petroleum resources and former vice president of Standard Oil Company (N. J.), who was retained as NSRB consultant.

Reactions to the NSRB staff proposals undoubtedly will echo in Congress and throughout the industry for months and perhaps years. Strong opposition already has been voiced by the Independent Petroleum Association of America. Surveying the proposal to reduce domestic output, the association condemns it as "inimical to national security, unrealistic as a means to the end sought, impractical of operation, unfair to the taxpayer and beneficial only to certain large American foreign oil operators seeking to capture the domestic crude oil market." The IPAA describes the plan as "defeatist in character" and asserts that it might lead to subsidization of the domestic industry with a tax burden to all citizens, that it would mean "complete federal regulation of the industry with all of the attendant cost, iniquity and uncertainty" and would "render unemployed a large segment" of domestic oil workers.

Whether the import features could be adopted without depressing domestic crude prices is a concern of many independents and some in government circles wonder if a higher import tax might not antagonize hemispheric neighbors on whom this country must rely for supplies. The theory of "superior" and "inferior" petroleum uses is certain to come in for spirited debate. The basic issue of how much federal control would be required to carry out any such plan is perhaps the nub of industry reaction to it.

A new federal agency would have to be created to carry out the plan, if it were adopted, many

(Continued on page 96)

* See WORLD PETROLEUM, October, 1948, "Economic Aspects of Railway Dieselization."

HYDRAFRAC PROCESS INCREASES P

New Method Opens Cracks in Sand or Limestone by Hydraulic Means and Keeps the Cracks Open So That Oil Will Flow More Readily.

Acid has been used to increase production of more than 200,000 oil wells, but acid will not attack limestone to open passages for the inlet of oil. Stanolind Oil & Gas Co. recently described a method of opening cracks in sandstone by hydraulic pressure and of keeping them open by injecting hard pellets into the cracks opened by hydraulic means. The hydraulic fluid usually is jellied petroleum similar to that used by flame throwers in World War II. The accompanying article by Engineer J. B. Clark tells how the process is accomplished and results which have been obtained. —Editor.

ALTHOUGH explosives, acidizing and other methods have long been used, there still exists a need for artificial means of improving the productive ability of oil and gas wells, particularly for wells which produce from formations which do not react readily to acids. This paper discusses the development of a hydraulic fracturing process, "Hydrafrac," which shows distinct promise of increasing production rates from wells producing from any type formation.

Figure 1 shows a simplified cross-sectional view of a well treated by one version of the process. The first step, formation breakdown, is done with a viscous fluid, usually consisting of an oil such as crude oil or gasoline, to which has been added a bodying agent. Due to availability and price, war-surplus Napalm has been used in the majority of experiments to date. Napalm is the soap which was used in the war to make "jellied gasoline." The next step consists of breaking down the viscosity of the gel by injecting a gel-breaker solution and then, after several hours, putting the well back on production. The accompanying photograph shows a typical field hookup. The base fluid is picked up by the mixing pump and pumped through the jet mixer where the granular soap is added. Next it goes into a small mixing tub from which the high-pressure pump takes suction. The solution is then pumped into the well. The breaker solution is then taken from an extra tank and is displaced into the well immediately following the gel. When required, additional trucks may be connected to the well so as to pump the fluids at a faster rate.

The usual hydraulic fluid requirement is for an oil phase material with viscosity between 50 and 150 centipoises or higher, depending on the individual job. It has been found that Napalm soap and similar soaps provide the desired characteristics. Napalm can be added to gasoline, kerosene or other refined petroleum cuts to produce gels having any desired viscosity up to considerably over 300 centipoises.

The ideal fluid should be an oily one rather than a water base fluid to avoid decreasing the permeability of the formation to oil or gas. This requirement is met by the Napalm gel being used.

Water base fluids, however, would be advantageous in treating water wells, or water injection wells used in either the oil industry or industries where water is used in solution mining of salts and in the Frasch process of mining sulfur. There is also some reason to believe that a water base fluid could be used successfully in oil or gas wells. In other words, it is entirely possible that the benefits derived from hydraulically fracturing the formation may be great enough to overcome the decrease in permeability caused by water wetting of the oil or gas sand. It is known, for example, that limestone reservoirs can be acidized with an acid solution that is as high as 80 or 90 percent water, with a resulting increase in well productivity. Future work with this process may indicate that it is more economical to use a water base for the hydraulic fracturing fluids than the more expensive gasoline and crude oil base fluids, particularly in formations not appreciably contaminated with argillaceous materials.

It is often desirable that the hydraulic fluid should carry in suspension a sufficient amount of strong granular material such as sand to be used as a propping agent to keep the fracture from closing off after release of pressure. The high viscosity of the Napalm gels makes them well suited to transport such material.

After the fracture is made, the fracturing fluid must be thin enough to flow back out of the well. The Napalm gels have the advantage of being relatively unstable, so that the viscosity of the solution will revert to approximately that of the base oil after the fracture is formed.

A further advantage of the Napalm gel is that its time of reversion to a sol is controllable within definite limits. For example, it has been found that ½ to one percent of water added to a Napalm-gasoline gel will cause reversion to a sol within eight to 24 hours, which gives ample time for performing the Hydrafrac job. Napalm-gasoline gels will revert to sols within an hour or two if they are in quiescent contact with either salt water or many types of crudes. Furthermore, it is also possible to use solutions which will break these gels in a few minutes under quiescent contact condition. One example is a two percent solution of petroleum sulfonates in gasoline or crude oil which makes it possible to follow the gel with a second solution to insure its more rapid reversion to the sol condition.

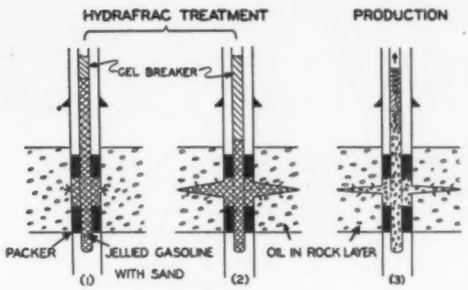
Starting with well depth, fluid viscosity, formation thickness and permeability and bottom hole pressure, it is possible to compute with fair accuracy the pump rate necessary to fracture a formation and to extend the fracture after it is first made. Field experience has shown that the suc-

East Texas well being treated. Powder is being poured into mixers for production of jellied gasoline. High pressure injection pumps are mounted on trucks at right, Gel breaker chemical in truck at left.

* Condensation of paper presented before the petroleum division of the American Institute of Mining and Metallurgical Engineers, Dallas, Tex.

PRODUCTION

By J. B. Clark*
Stanolind Oil & Gas Co.



How the Hydrofrac treatment opens cracks in producing horizon, and keeps them open.

cessful Hydrafrac treatment requires a definite fracturing of the formation, as indicated by a decrease in injection pressure. Table I below compares calculated breakdown pressures with those observed in the field. A comparison of the data presented indicates a close agreement between the two figures.

Table I

Calculated vs. Actual Formation Breakdown Pressures

Field	Well	Bottom Hole Pressure (psi) Calculated	Actual
East Texas	GA	3000	3350
Rangely, Colorado	EF	4800	4900
Hugoton, Kansas	AA	2500	2000
East Sasakwa, Okla.	FA	2600	2400
Frannie, Wyoming	BB	2700	2750

Table II illustrates typical results of such advance computations. It is apparent from this table that, in formations of normal permeability, it is impossible to employ a fluid of high penetrating ability such as the usual low-viscosity crude oil for fracturing or extending the fracture. On sands such as in the East Texas field it would require a crude oil injection rate of 21 barrels per minute at approximately 2,000 psi in order to fracture the formation, which is beyond practical limits since the largest portable oil field pumps deliver only about three barrels per minute at this pressure. However, by using a higher viscosity material such as a 100 centipoise gel, the pump requirements are dropped to within practical limits both for fracturing and for extending the fracture.

Table II

Pump Rate to Fracture Hydraulically

	East Sasakwa Booch Sand	Hugoton Field Ft. Riley Lime	East Texas Field Woodbine Sand
Amount of open hole	35 ft	35 ft	20 ft
Average formation permeability	150 md	13 md	200 md
Bbl/min to fracture			
Crude oil—5 centipoises	11	11	213
Gel—100 centipoises	0.1	.007	1
Bbl/min to extend fracture to 50 ft radius			
Crude oil—5 centipoises	11	.1	213
Gel—100 centipoises	0.6	0.05	10.7
Pressure to fracture	2100* 1250**	1700* 900**	2900* 1700**
Pressure to extend fracture	1700* 850**	1350* 550**	2600* 1400**

* Bottom hole pressure (psi)
** Surface pressure (psi)

In wells where the exposed sand section is very thick, special precautions must be taken so that the hydraulic fracturing operation can be performed at more than one depth. Ordinarily the formation will fracture but once, and the relative increase in production due to this single fracture might be negligible in a well having a large amount of productive sand thickness. To obtain the benefits of multiple fracturing, it is necessary to set special formation packers against the wall of the hole so as to isolate sections of a few feet in thickness before applying the Hydrafrac process. This technique is also important where it is necessary to prevent the fracturing fluids from entering non-productive formations which may alternate with the producing zones exposed to the well. Packers are also required in some instances to keep the high pressures of the process from injuring pipe. Inflatable packers have been found best for this work, but due to the fact that such packers are still in the development stage, considerable mechanical difficulty has been experienced with them.

The Hydrafrac process is accompanied by considerable hazard to personnel. The materials usually used are inflammable and explosive, and this, together with the use of internal combustion engines, makes this process rather hazardous. It is believed, however, that by exercising due caution such as covering mixing tubs and piping off engine exhausts, this process need not be more hazardous than the handling of any other inflammable liquid. The treating solutions have not ignited on any of the jobs done to date.

The experimental application of the Hydrafrac process to oil and gas wells has resulted in sustained and significant increase in productivity on 11 well out of the 23 in which it has been tried. Six of these 11 successes are gas wells in the Hugoton field; in one instance, a combination Hydrafrac-acid job was done, resulting in increasing deliverability from 52 to 439 MCF per day. An increase from 53 to 322 MCF per day was the result of the Hydrafrac treatment, with a further increase to 439 MCF per day being the result of the subsequent acid job.

A much stronger case for the economic possibilities of the process is found in the five oil wells in which Hydrafrac has given sustained production increases. These are as follows:

In the Frannie field, Wyoming, well BB increased from 60 to approximately 160 barrels per day, and the well BC from 60 to 72 barrels per day as the result of Hydrafrac treatment; both these increases have been sustained for over a year.

In the East Sasakwa field, Oklahoma, well FA, which was producing no oil and was to be abandoned, has produced from five to six barrels per day for nine months since Hydrafrac treatment. In the East Texas field, well GA which had produced no oil for two years produced more than 50 barrels of oil per day for several weeks while under special test after a Hydrafrac treatment, before being returned to its 20 barrels per day allowable rate. This well has been producing at the 20 barrels per day rate for five months since then, with periodic productivity tests to determine the maximum potential of the well. The last special test of this type indicated a well potential of 61 barrels of oil per day.

In the Rangely field, Colorado, well EF which was producing approximately 75 barrels of oil per day before treatment is now producing approximately 140 barrels per day as the result of Hydrafrac treatments.

No increase in production was obtained in 12 of the 23 wells treated in the preliminary experimental program. Considering the many variables involved and the imperfections of present special packers, the proportion of failures at this stage of development is not discouraging. Both theory and field experience show that it is necessary to obtain a definite formation breakdown in order for the process to function satisfactorily.

If the engineering factors surrounding a proposed Hydrafrac job are known, experience has shown that a correct prediction of success or failure of the job is usually possible. A careful review of the jobs done to date leads to the conclusion that, even with due regard to the fact that "hindsight is clearer than foresight," it would have been possible to predict correctly at least 75 percent of the failures and 95 percent of the successes, had all of the present field experience been available before each of the jobs done. As a matter of fact, many of the failures were predicted as such, and the jobs purposely done in the face of unfavorable well conditions in order to obtain research data. One of the treatments done under such circumstances (well FA) was successful in spite of predicted failure.

When put into routine commercial use, the cost should not be much more than the cost of an acid job of corresponding gallonage. Where crude oil from the lease can be used as the base fluid in the Hydrafrac process, it is probable that the cost will be less than that for acidizing

It is significant that the value of the additional oil and gas produced to date through the benefits of this process already has amounted to approximately 95 percent of the combined cost of research, development and all field tests.

CAMBRIAN SYSTEM ADDS DEEPER ROCKY MOUNTAIN OBJECTIVE

JOSEPH A. KORNFELD

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RECENT discovery of important oil production from rocks of Cambrian age (lower Paleozoic) in the Sweetwater uplift section of the Green river basin of southern Wyoming throws new light on geologically-deeper objectives for the Rocky Mountain province.

Significance of the deep Cambrian oil discovery at Little Lost Soldier may be interpreted as follows:

(1) It marks the first commercial oil production to be encountered in the oldest Paleozoic rocks in the Rocky Mountain province. Although live-oil saturation was logged in a sandstone of Cambrian age in a well drilled during 1945 at South Oregon Basin in Park County, Wyoming, the showing then encountered in Cambrian rocks indicated possibilities of production from formations older than any now commercially productive in Wyoming.

(2) Cambrian sand production is proving highly prolific elsewhere in other geologic basins; in the Brunson pool of eastern Lea County, New Mexico, high-gravity flowing wells have been completed recently in rocks of upper Cambrian age below truncated Ellenberger (Ordovician) oil production. However, this province is related to the West Texas basin-and-range type structure.

(3) Other lower Paleozoic objectives will be studied for the purpose of setting up initial geologic objectives on deep wildcat tests or for deepening old wells on producing structures in search of older possible oil and gas pays; gas is now being produced from rocks of Devonian age in the San Juan basin of northwestern New Mexico. Prolific oil production from Devonian dolomite at Leduc in Alberta in the northern Great Plains Basin is commanding the attention of both American and Canadian oil companies.[1]

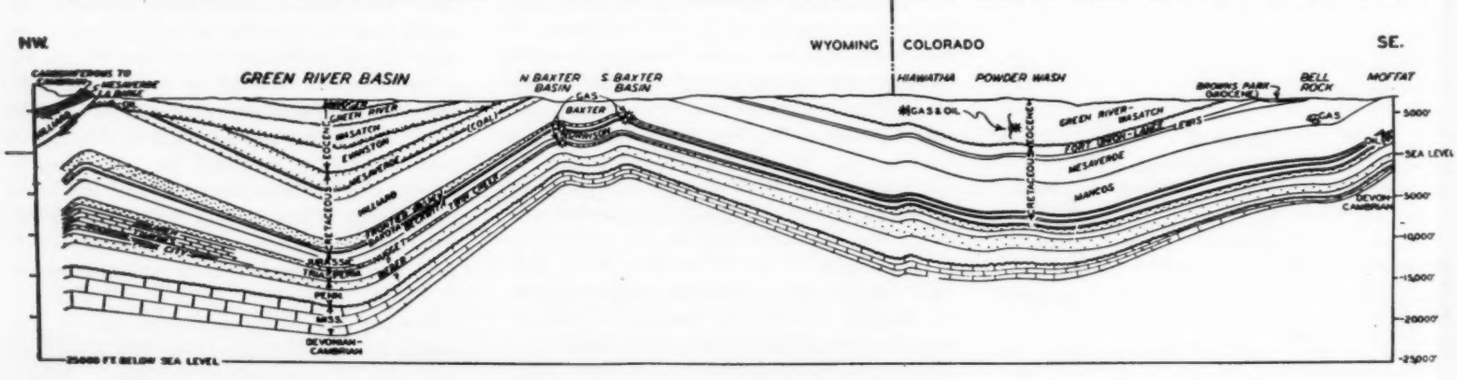
The Little Lost Soldier has proven to be the most prolific oil field in Wyoming from the standpoint of cumulative recovery per acre, the high percentage of high-yield wells, productive relief, and the larger uumber of reservoirs.

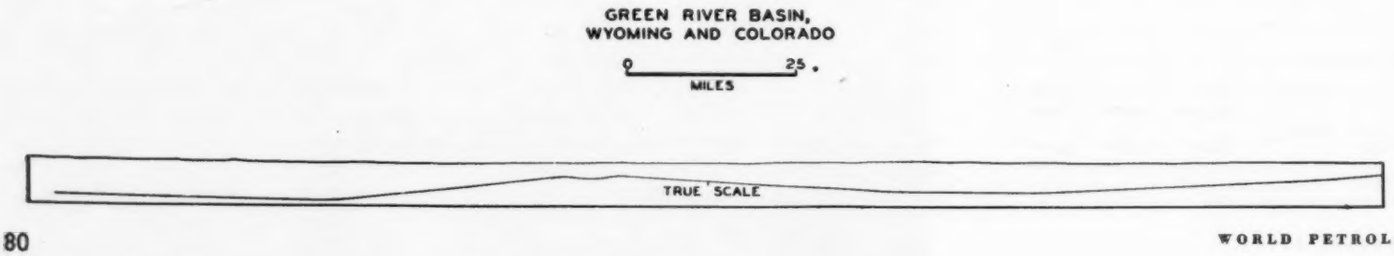
Several wells in the field have produced in excess of a million barrels of oil per well. A total of 13 reservoirs now producing range in geologic age from the upper Cretaceous down into the Cambrian of the lower Paleozoic system, from 200 down to 6,172 feet.

Geologically, the deepest production for the province, the Cambrian was found productive in the Little Lost Soldier field in northeastern Sweetwater county. The discovery is Sinclair Wyoming Oil Company's Drayton-Consolidated No. 2, located in the SE NE SE/4 of Section 3-26n-90w, an old well drilled deeper from a total depth of 4,772 feet. Rocks of Cambrian age were topped at 5,475 feet (1,579 feet above sea level) in drilling to a total depth of 6,288

[1] See WORLD PETROLEUM, March, 1941.

Fig. 1. Generalized northwest-southeast structural cross-section, Green River Basin, Wyoming and Colorado. For line of section, see regional structure map. (After Levorsen)





feet in the pre-Cambrian rocks topped at 6,150 feet (904 feet above sea level). Elevation is 7,054 feet, derrick-floor measurement.

A summary of drill stem tests taken above and in the Cambrian appears in Table 1. The 5-inch tubing was set and cemented at 5,965 feet with 190 sacks. The tubing string of 2⅜ inch pipe was swung at 6,275 feet, 11 feet off bottom.

Initial production tests were as follows:

Table 2

Production Gauges—Sinclair Wyoming Oil Co. Drayton-Consolidated No. 2 SE NE SE/4 of Sec. 3-26n-90w,

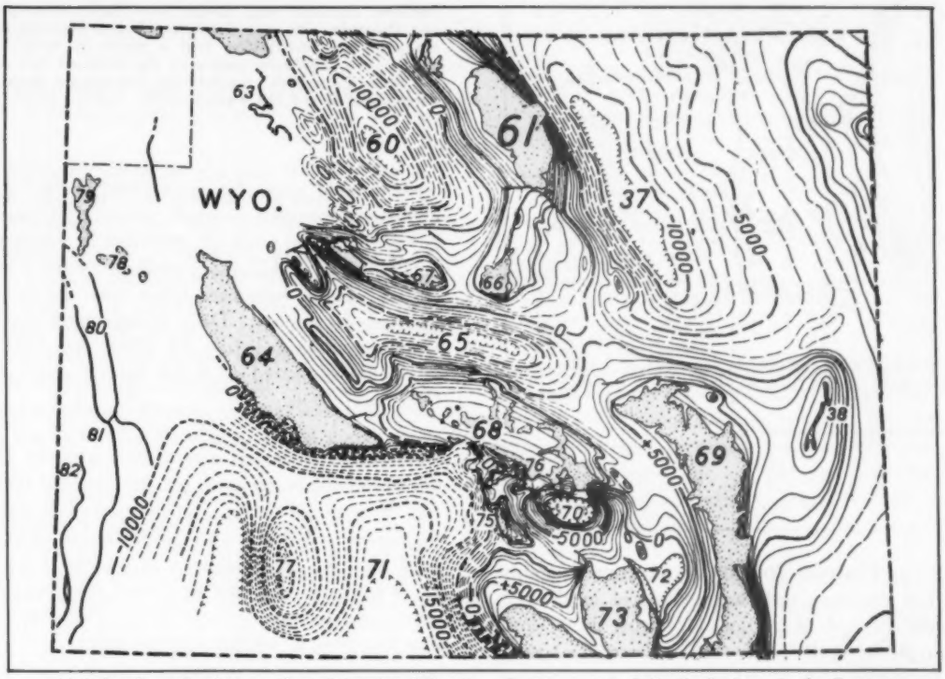
Oil	Wtr.	Period	Method
156	5% B S & W	12 hours	Flowing natural
172	....	12 hours	Gas lift
435	3/10 of 1 pct.	17 hours	Flowing natural
720	....	24 hours	Gas lift/2,000 gal. acid.

Sinclair Wyoming Oil Company posted a purchase price for Cambrian crude oil in the Rocky Mountain region effective June 21, 1948. For 20° and below the price is $2.10 per barrel with an increase of two cents per degree differential up to $2.52 for 40 and above.

Gravity of the Cambrian oil at Lost Soldier is approximately 34.5 deg. API.

Meanwhile a deepening program was resumed in the vicinity of the Cambrian discovery for other objectives including the Amsden and Mississippian formations of Paleozoic age which are adding substantial reserves to this prolific field.

The first two fields in Wyoming to find commercial oil production in the Amsden formation are the Little Lost Soldier and the Wertz fields. The Amsden was first indicated for production at Little Lost Soldier field on drill-stem test during November of 1947 at Sinclair Prairie Oil Company's Union 77-1, located in the SE NE NE/4 of Section 10-26n-90w. Surface elevation was 6,897 d.f. Amsden sand was topped at 4,625 feet with saturation logged from 4,640 feet. Results of two drill-stem tests taken in this formation were as follows:



Attitude of pre-Cambrian rocks in Wyoming (after Rycroft Moss, etal, Bull. Geol. Soc. Am.) Contour interval is 1,000 feet. The yellow overlay outlines outcrops of the pre-Cambrian formations. Numerals refer to various tectonic features as follows: (37) Power River Basin; (38) Hartville Uplift; (6) Bighorn Basin; (61) Bighorn Mountains Uplift; (63) Heart Mountain Overthrust; (64) Wind River Mountains Uplift and Overthrust; (65) Wind River Basin; (66) Bridger Uplift; (67) Owl Creek Mountains Uplift; (68) Sweetwater Anticline; (69) Laramie Mountains Uplift; (70) Hanna Basin; (71) Green River Basin; (72) Rock Creek Basin; (73) Medicine Bow Mountains Uplift; (75) Rawlins Uplift; (76) Seminoe Uplift; (77) Rock Springs Uplift; (78) Gros Ventre Range; (79) Teton Range; (80) Darby Overthrust; (81) Absaroka Overthrust; (82) Crawford Overthrust.

Table 1

Summary of Drill-Stem Tests Sinclair Wyoming Oil Co. Drayton-Consolidated No. 2 SE NE SE/4 of Sec. 3-26n-90w. (Surface Elevation: 7,054' d.f.)

Packer Seat	Total Depth	Testing Tool Open For	Choke Sizes	Recovery
5,466' (+1,588)	5,515' (+1,539)	45 min.	—	270' oil-cut mud; cut 15 per cent.
5,584' (+1,470')	5,655' (+1,399)	30 min.	¾"	40' drilling mud.
5,961' (+1,093')	6,026' (+1,028)	30 min.	¼"	1,260' 33.9 API gravity oil; 380' oil and gas-cut mud; 15% oil and 180' thin muddy water.
5,961' (+1,093)	6,026' (+1,028)	—	—	oil to surface in 50 min. flowed 96 barrels of oil in 9 hours with 22 MCF gas.
6,023' (+1,031)	6,094' (+960)	30 min.	—	1,020' oil and 30' mud.
6,096' (+958)	6,172' (+882)	30 min.	¼"	2,790' of oil (34.5 deg. API gravity) 270' of 20 per cent mud-cut oil.
6,170' (+884)	6,242' (+812)	30 min.	¼"	30' mud; 90' of 5% oil-cut mud.
6,232' (+822)	6,281' (+773)	30 min.	¼"	80' mud; no water.
4,622' (+2,275)	4,676' (+2,221)	30 min.	¼"	546' 34.7 oil 591' 30 pct. mud-cut oil 46' mud.
4,675' (+2,222)	4,733' (+2,164)	30 min	¼"	1,355' 35.7 oil; 30' mud

However, this well was drilled deeper to a total depth of 5,039 feet and completed in a still deeper objective—the MADISON (Mississippian) limestome which was logged from 4,950 to 5,030 feet; initial flow gauge was 1,045 barrels of 35. deg. API oil through 2⅜-inch tubing on January 9, 1948.

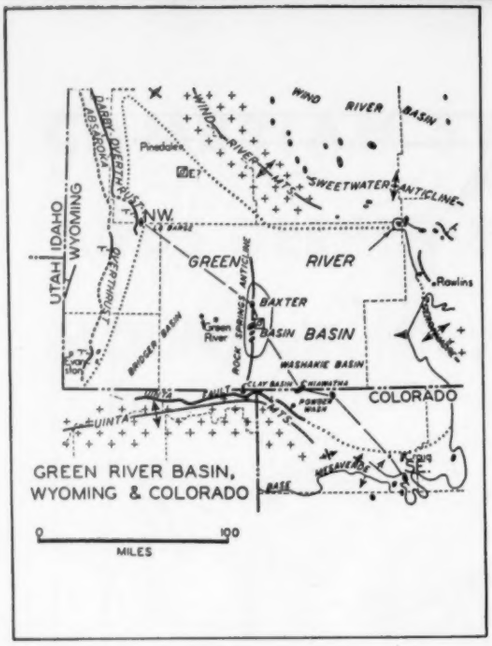
Two miles east of the new deep development at Lost Soldier, two new deep pay zones have been discovered recently in rocks of Pennsylvanian and Mississippian age.

The Darby sand of the Amsden formation was proven for production on February 29, 1948 by Sinclair Wyoming Oil Company's Unit No. 22, located in the SE SE SE/4 of Section 1-26n-90w. An old Tensleep oil well drilled deeper from 6,635 feet, it topped the Amsden at 6,418 feet and on drill-stem test from 6,508-6,555 feet flowed 35 barrels of 35 gravity oil in 35 minutes; initial completion gauge was 595 barrels per day.

The Madison (Mississippian) lime was discovered at Wertz on April 30, 1948 at same interests' Wertz "D"-2, located in the SE WE NE/4 of Section 1-26n-90w. An old well drilled deeper to a new total depth of 7,193 feet, it was recompleted from 6,751 to 6,820 feet in the Madison; initial production was 1,163 barrels of 36 gravity oil per day through open tubing.

The new development consists primarily of deepening old Tensleep oil wells. There are now 32 wells producing from the Tensleep (Pennsylvanian) at Wertz which contributes 5,000 barrels of oil per day. The crude oil is transported by Sinclair's own pipeline to their refinery near the town of Rawlins, 35 miles to the south.

The Little Lost Soldier field is an elliptical, faulted dome with approximately 3,500 feet of closure. It is situated in sections 2, 3, 10 and



Regional structure map, Green River Basin, Wyoming and Colorado. The new Cambrian oil pay discovery in the old Little Lost Soldier field is shown by arrow in northeastern Sweetwater county on the northeast limb of the Green River Basin; the field lies between the Sweetwater anticline and the Rawlins uplift. (After Levorsen)

11 in Township 26n-90w in Sweetwater county. The discovery well was completed in the SW SW NW/4 of Section 11 during June, 1916 from the Well Creek (upper Cretaceous) sandstone from 265 to 340 feet for an initial production of 200 barrels of oil per day.

Five years later, the Dakota sandstone was proven productive from completion of a well in the northwest quarter of section 11 from a total depth of 1,400 feet. Two years later, the Lakota (Comanchean Cretaceous) was proven productive from a total depth of 1,530 feet. The Sundance (Jurassic) sandstone was brought in during 1925 when a well drilled in the southwest of the northwest quarter of section 11 was completed from 2,015 to 2,040 feet for an initial output of 200 barrels of oil per day.

During November, 1930 Tensleep (Pennsylvanian) was added with completion of a well drilled in the southwest of the northwest quarter of section 11 from 3,942 to 4,009 feet; initial output was 1,800 barrels per day. The Tensleep reservoir had an initial revservoir pressure of 1,903 psi. It is proven over an area exceeding 1,300 acres. Gas is returned to the formation to maintain reservoir pressure. Cumulative production from all reservoirs to January 1, 1946 was 32,422,012 barrels of which 21,195,643 barrels have been taken from the post-Tensleep formations. Daily average production for the week ended June 26, 1948, was 6,690 barrels as compared to 6,250 barrels daily in December, 1946.

The Wertz dome lies east of and adjacent to the Lost Soldier structure but its crest is 2,000 feet structurally lower. It is a symmetrical, slightly-faulted dome with 1,200 feet of structural closure. It is situated in sections 1 and 12 in township 26n-90w in eastern Sweetwater county and in sections 6, 7, 17 and 18 in township 26n-89w, in western Carbon county.

The discovery gas well was completed during September of 1920 in the northeast quarter of the southwest quarter of section 7-26n-89w, from the Dakota sandstone series from 3,427 to 3,435 feet for an initial open flow potential of 42,000,000 cubic feet of gas. Two years later, a deeper gas reservoir was uncovered in the Lakota (lower Cretaceous) from 3,549 to 3,610 feet for an initial open-flow potential of 6,000,000 cubic feet of gas per day. The Sundance (Jurassic) sandstone was proven productive for gas the following year with completion of a well in the northwest of the northwest quarter of section 7 for an initial open-flow potential of 57,000,000 cubic feet of gas per day from a depth of 4,150 feet.

The discovery oil well at Wertz was completed in December of 1936 at Sinclair Wyoming Oil Company's Wertz 10-A, located in the southwest southeast northwest quarter of section 7-26n-89w, it was originally completed from 5,863 to 5,886 feet in the upper part of the Tensleep for an initial production of 2,000 barrels of 35 gravity oil per day. It was later deepened from an old total depth of 5,896 to 6,161 feet producing 8,350 barrels of oil the first 24 hours on recompletion.

Cumulative production from all reservoirs at Wertz to January 1, 1947 was 13,197,354 barrels from an oil area of 650 acres. Total gas withdrawals produced to the same date was 66,013 million cubic feet from 1,840 gas acres. Daily average production for the week ended June 26, 1948 was 5,595 barrels.

Pressure maintenance of the Tensleep reservoir is carried on under unit operation.

The Bunker Hill structure is a faulted, elongated dome squeezed in between the Ferris Mountains and the Wertz dome. It occupies portions of section 29 and 32 in township 27n-89w. The field produces gas from the Steele (Upper Cretaceous) formation. The discovery gas well was completed during August of 1937 by the Ohio Oil Company in the southeast of the southwest quarter of section 29-27n-89w, for an initial open-flow potential of 5,000,000 cubic feet of gas per day from 1,224 to 1,480 feet. Initial reservoir pressure of 530 pounds has dropped to 310 psi by the end of 1946. At that date, cumulative gas withdrawals were 1,663 million cubic feet from four wells on 550 acres. The Madison formation was tested in the deepest well in the field which was taken to 9,392 feet.

The Mahoney dome lies ten miles southeast of the Wertz dome and along the same major structural axis. It exhibits a broad, fairly-flat crestal area.* The structure is highly unsymmetrical and is unique in that it reflects two centers of curvature. Although the independent closure above the structural saddle that separates Mahoney and West Ferris dome to the east amounts

*J. S. Irwin, *Structure of Typical American Oil-Fields*, 1929.

Table 3

Tentative Correlation Chart of the Devonian of the Rocky Mountain Region

Reference: Cooper, G. Arthur (Chairman) "Correlation of the Devonian Sedimentary Formation of North America," Bull. G. S. A., Vol. 53, pp. 1729-1794, (1942). (Rocky Mountain Section Prepared by G. A. Cooper, Edwin Kirk, C. W. Merriam.)

Overlying Formation: STANDARD SECTION			NORTHEAST UTAH	NORTH-WESTERN AND WESTERN WYOMING	SOUTHWEST MONTANA	NORTHWEST MONTANA	IDAHO
				Mississippian		(Madison)	(Mileage)
Europe	Series	Stage					
FAMENNIAN	Bradfordian	Conewango	"Threeforks"		"Threeforks" shale		
?	Chautauquan	Cassadoga			"Threeforks" shale	Spotted Br. Lone Butte	Milligen (part). Threeforks
FRASNIAN	Senecan	Chemung	Darby	Darby	Darby	Coopers Lk. Glenn Cr.	Limestone Jefferson
GIVETIAN		Finger Lakes	Jefferson	Limestone	Jefferson	White Ridge	Limestone
—	Erian	Taghanic Tioughnioga Cazenovia					
EIFERLIAN							
COBLENZIAN	Ulsterian	Onesquethaw Deerpark	Beartooth Butte Limestone				
GEDINNIAN		Helderberg					
Underlying formation			Silurian (Laketown)	Ordovician (Bighorn)	Upper	Cambrian	Silurian (Laketown)

to only 350 feet, the effective structural closure exceeds 2,000 feet. The surface rock is Niobrara shale (upper Cretaceous) although masked in part by Recent dune sand. The dome lies in the southern part of township 26n-88w, and the northern part of township 25n-88w, in Carbon county.

The field was discovered during 1919 by the Kasoming Oil Company who completed a gas well on the crest of the structure in the SW SW NE/4 of Section 34-26n-88w. It encountered production at a depth of 2,160 feet in the Dakota sand series of the upper Cretaceous for an initial open flow of 30 million cubic feet of gas per day. Six years later, a deeper gas pay was found in the Sundance sand of the Jurassic from 2,788 to 2,900 feet for an initial flow of 20 million cubic feet per day; initial pressure was 1,220 pounds per square inch.

The first old well was brought in during May of 1930 by Producers and Refiners Corporation and Midwest Refining Company. Producing formation was the Tensleep (Pennsylvanian) sand logged from 4,600 to 4,682 feet; the well was plugged back from a total depth of 4,760 feet. Initial gauge was 75 barrels of oil per day.

Development of the Tensleep reservoir was resumed during October of 1938 with completion of Sinclair Wyoming Oil Company's Mahoney 3, in the C SE NW/4 of Section 34-26n-88w which was drilled on the crest of the structure. Tensleep sand was topped at 4,295 feet and penetrated to 4,486 feet. Initial flow rate was 635 barrels of oil per day through the casing but after being tubed it tanked 172 barrels daily. In November of 1940 it was deepened to 4,505 feet and recompleted for 511 barrels of oil in 15½ hours, discovering a deeper pay. An east offset was drilled in 1939 at Mahoney 2-A and completed at 4,507 feet for 80 barrels. However, in December of 1940 it was drilled deeper and recompleted for 596 barrels from a total depth of 4,520 feet. In March, 1941, the Tensleep was extended to the west by Mahoney 4-F, in the C SW NW/4 of Section 34-26n-88w; it was completed for 766 barrels of oil in 24 hours through a choke on the tubing. Total depth was 4,532 feet in the Tensleep topped at 4,408 feet with 7-inch pipe set at 4,410 feet.

The Cambrian has been tested in a well drilled to 5,366 feet without favorable results.

Cumulative oil production to January 1, 1947 was 2,142,954 barrels from 400 acres in the West Mahoney field and 105,693 barrels from 80 acres in the East Mahoney field. Currently, Mahoney is producing 365 barrels per day.

Gas withdrawals from the East Mahoney field totaled 35,800 million cubic feet to January 1, 1947 from 1,600 acres in the Sundance (Jurassic) formation. While the initial pressures ranged from 820 to 1,220 pounds per square inch current pressure range is from 120 to 380 pounds. In the East Mahoney field, four gas wells have produced 58,465 million cubic feet from 1,120 acres.

Sinclair Wyoming Oil Company operates the West Mahoney field as a unit.

Fifty miles south of the Lost Soldier district, the Tensleep (Pennsylvania) formation is under development in the old Hatfield gas field of Carbon county. The field, situated south of the Rawlins uplift, was discovered in November of 1923. To January 1, 1947, the field produced 5,358 million cubic feet of gas from two wells proving 320 acres; the producing formation was the Muddy sand of the Upper Cretaceous series; 12 feet of pay was logged at 3,750 feet. Structure is a faulted dome.

The Tensleep discovery oil well was Ohio Oil Company's Government No. 1, located in the NE SE NW/4 of Section 2-19n-88w. Tensleep sand objective was topped at 5,805 feet (1,414′ above sea level) with saturation logged from 5,815 feet where the 4½-inch oil string was set and cemented; it was completed on November 15, 1947 for an initial flow of 300 barrels of 43.2 gravity oil following a 76-quart nitroglycerine shot.

The Dakota sandstone was proven for gas during February of 1948 at Ohio Oil Company's Union Pacific 2, in the SW SE/4 of Section 35-20n-88w, one-half mile northeast of the Tensleep discovery oil well. The well was finaled as a dual completion late in March, 1948 for approximately 1,000 barrels of oil per day from the Tensleep and 4,000,000 cubic feet of gas per day from the Dakota. Originally, the well was drilled to a total depth of 6,116 feet; it was plugged back to 6,072 feet and pipe cemented at 5,784 feet on top of the Tensleep. The Tensleep is being produced through the tubing and the Dakota through the annulus from casing perforation between 3,895 to 3,915 feet (41 holes). The oil is trucked to the Sinclair refinery at Parco. The gas is piped to Rawlins by Rocky Mountain gas Company, a subsidiary of the Ohio Oil Company. Other fields supplying Rawlins include Belle Springs, Ferris, Mahoney, and Bunker Hill.

Green River basin extends over more than 18,000 square miles in northwestern Colorado and southwestern Wyoming.* The area is bounded as follows:

West, the Absaroka and Darby overthrusts trending from north to south along the western boundary of Wyoming; South, the east-west trending Uinta Mountains lying in northeastern Utah and northwestern Colorado; this is accomplished by a geosynclinal boundary fault known as the Uinta fault which lies immediately south of the Wyoming-Utah state boundary line; East, the northwest-southeast trending Sierra Madre uplift; and the north-south arcuate Rawlins Uplift; North, the Sweetwater anticline and the Wind River Mountains.

* Levorsen, A. I., Possible Future Oil Provinces of the United States and Canada, 1941.

Table 4

Rank of Wyoming Among the States in Exploration
Source: Statistical Bulletin, Interstate Oil Compact Commission, June, 1948

Rank	State	geophysical: Seismic	Gravity	Magnetometer	Total	Core Drill	Total Units
1.	Total Texas	156	29	0	185	4	189
2.	Total Louisiana	86	26	0	112	1	113
3.	Oklahoma	47	3	0	50	4	54
4.	Wyoming	39	12	0	51	0	51
5.	Mississippi	22	8	1	31	4	35

Regionally, the Green River basin is divided by the north-south trending Rocky Springs Anticline into two local basins: (a) the Bridger basin of western Sweetwater, eastern Uinta and eastern Lincoln counties, and (b) the Washakie Basin of eastern Sweetwater county and western Carbon county.

The Rock Springs anticline in central Sweetwater county contains three local structures each of which is separated from the others by low saddles modified by considerable faulting; these are known as the North Baxter, Middle Baxter and South Baxter structures. Structural relationships of the Green River basin are shown in Figure 1 entitled "Generalized Structural Cross-Section, Green River Basin, Wyoming and Colorado."

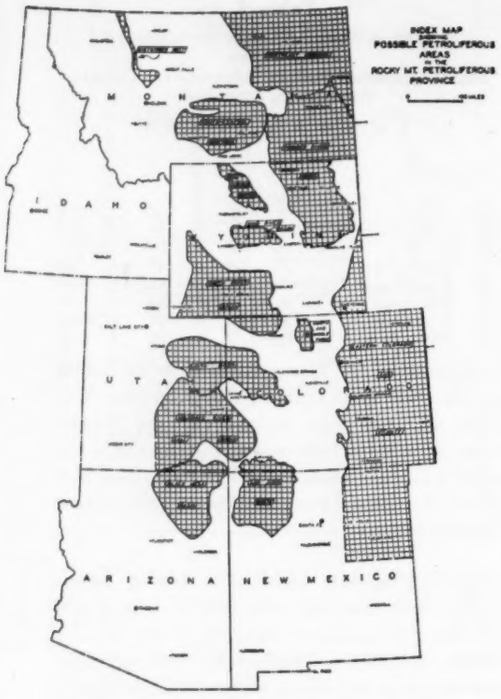
The general relations of the Cambrian sedimentary rocks in central Wyoming were described as follows:*

> "The sandstone of the Deadwood formation is at the base of the sedimentary series in northern and central Wyoming. It thins out to the southeast and apparently ceases at no great distance east of longitude 107°, so that in Converse, Albany, and Laramie counties the Carboniferous rocks lie directly on pre-Cambrian granites and schists."

Black Hills, South Dakota. The Cambrian Deadwood formation of the Black Hills is described as follows:†

> The outcrop of the Deadwood formation encircles the Black Hills, appearing usually in the base of the great infacing limestone escarpment. It lies on a relatively smooth surface of Algonkian rocks, although there are many local irregularities of shore lines and beach phenomena. The rocks are mostly sandstones and sandy shales, with frequent occurrences of basal conglomerate. In the southern hill, the thickness varies from four feet to 50 feet in greater part, and the principal material is a coarse dark-brown massive sandstone. To the northward the formation gradually thickens, apparently by the addition of higher beds comprising dark-gray shales, mostly sandy, and beds of sandstone. In the region around Deadwood, where the formation attains its greatest thickness of over 400 feet, it comprises about 30 feet of basal conglomerate

* N. H. Darton, Bull. Geol. Soc. America, vol. 19, 1908.
† N. H. Darton, Bull. Geol. Soc. America, vol. 19, Survey, 1901.



The various basins of the Rocky Mountain province are shown in the yellow overlay on the base map. (After Levorsen)

overlain by 30 feet of coarse dark-brown sandstone; 200 to 400 feet of gray shales, with layers of flagg limestone, limestone conglomerate, and sandstone; a conspicuous member of hard massive sandstone five to 12 feet thick; and at the top 20 to 45 feet of green shales. The limestone conglomerate is a very characteristic rock, consisting of flat pebbles and flakes of limestone more or less thickly sprinkled with glauconite grains, and is of the intraformational type.

Throughout its course, the formation contains fossils of which the following middle Cambrian forms have been reported by C. D. Walcott: Obolus, Hyloithes, Dicellomus, Asaphiscus, Olenoides, Ptychoparia, and Acrotreta.

Darton applied the name Deadwood to the Cambrian strata of the Owl Creek and Bighorn mountains for the sediments lying between the pre-Cambrian granitic and metamorphic rocks and the Bighorn dolomite.

Section of Deadwood formation in Wolf Creek canyon, west of Sheridan, Wyoming

White massive sandstone at base of Bighorn limestone	
Thin-bedded limestone, gray, greenish, and pinkish tints, with flat-pebble limestone conglomerate and glauconite	300
Gray and greenish shale with thin limestones and sandstones	300
Brown to buff massive sandstone; many fossils	50
Thin-bedded brown and gray sandstones	50
Gray sandstones and shales	35
Hard brown cross-bedded sandstone	6
Brown sandstone and sandy shale	30
Dirty-buff to brown and reddish soft cross-bedded sandstone, much glauconite; many fossils	20
Soft, greenish-gray sandstone	12
Buff sandstone with fossils	8
Dark-grey and greenish shales with thin sandstone beds above	200
Coarse-grained cross-bedded buff to brown, massive sandstone	30

Division of the Cambrian strata of northwestern Wyoming and southern Montana into three formations came from the work of Peale (1893) Blackwelder (1918) and Weed (1895) with the resulting classification:

Upper Cambrian:
Gallatin limestone.
Middle Cambrian:
Gros Ventre formation.
Flathead quartzite.

In the Wind River Mountains of Western Wyoming, Branson (1941) described the Gallatin, Gros Ventre and Flathead formations. Deiss (1938) in his study of the Cambrian formations and sections in part of the Cordilleran Trough, used the name Boysen formation to include the following members:

Upper: Grover Creek
Middle: Snowy Range
Lower: Maurice

Stipp* has measured 1,285 feet of Cambrian at Shoshone Canyon. The well section at Oregon basin shows 1,165 feet of Cambrian. Fanshawe (1939) records 1,110 feet at Wind River Canyon. Branson (1941) reports 1,145 feet of Cambrian strata in the Wind River Mountains. In the southwestern part of the Wind River basin and adjacent areas in central Wyoming, where the Cambrian is directly overlain by the Madison limestone, from 400 to 637 feet of Cambrian has been reported by Hares et al (1946).

Foster, (1947) in her study of the Paleozoic stratigraphy of the Northern Gros Ventre Mountains describes the Cambrian system outcrop in the southern part of the Gros Ventre River area where the Flathead quartzite, the Gros Ventre and Boysen formations are present. Here the Flathead quartzite is dominantly quartzite and sandstone, being commonly quartzite conglomerate near the base and grading upward into quartzite and then sandstone; some of the upper sandstones are interbedded with shale. The Gros Ventre formation is dominantly green and red shale with a little interbedded sandstone; however the Death Canyon member is a dark gray, buff-mottled limestone, and forms a prominent cliff, above and below which occur shale slopes. The upper part of the Gros Ventre is characterized by flat-pebble conglomerates. The Boysen is the uppermost Cam-

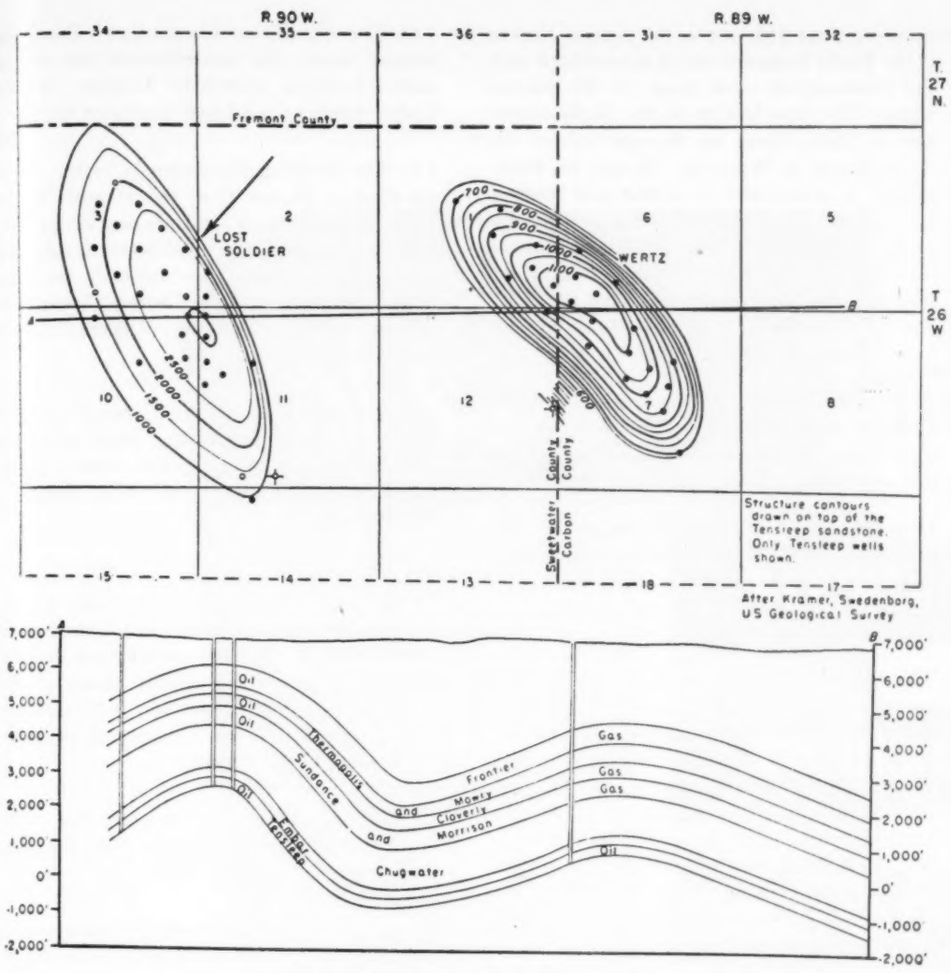
* Guidebook, Field Conference in the Bighorn Basin, 1947.

Table 5
Drilling Depth Records Rocky Mountain Region

State	County	Dome	Year Finished	Depth	Finished in Form. Geol. Age	Company	Fee	Description
COLORADO	RIO BLANCO	WILSON CREEK	1946	12,702	MADISON (MISS.)	CALIF. & TEXAS	Unit	20, Sec. 34-3n-94w.
NORTH DAKOTA	WILLIAMS	——	1938	10,281	—— (DEVONIAN)	CALIFORNIA CO.	Kemp	1, Sec. 3-154n-96w.
SOUTH DAKOTA	HARDING	——	1943	8,000	— ORDOVICIAN)	Northern Ordnance'	Harding School Land	1, Section 1-17n-1e.
MONTANA	GLACIER	MILK RIVER	1946	10,102	MADISON (MISS.)	Phillips Petroleum Company and Carter Oil Company's	Weazlehead	1, Section 28-34n-12w.
NEW MEXICO	(NW) SAN JUAN	BARKER	1945	9,468	———— (PENN.)	Southern Union Production Company's	Barker Dome	9, Section 21-32n-14w.
UTAH	CARBON	GORDON CREEK	1948	12,146	———(JURASSIC)	Pacific Western's	Unit	1—SE N.E. 14—Sec. 24-14s-7e.
WYOMING	NATRONA	W. POISON SPIDER	1948	14,309	FRONTIER (U. CRETACEOUS)	Pure Oil Company's	Unit	—NW SE/4 Sec. 11-33N-84w.

Table 6
Producing Depth Records Rocky Mountain Region

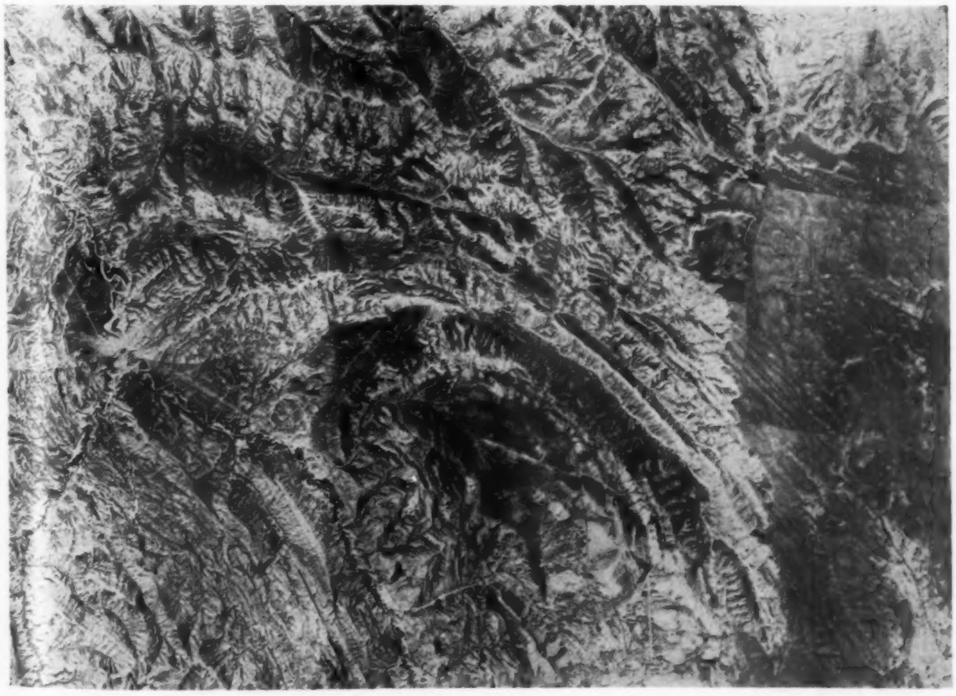
State	County	Field	Year Finished	Depth	Finished in Formation: Geol. Age.	Company	Fee	Description
COLORADO	RIO BLANCO	WILSON CREEK	1941	7,198	MORRISON (JURASSIC)	Calif. & Texas Co.'s	Unit	10, Section 26-3n-94w.
NORTH DAKOTA	BOWMAN	——	1941	1,500	EAGLE SD. (CRETACEOUS)	Montana-Dakota Utilities	Well No.	155, Section 10-130-107w/
MONTANA	CARBON	ELK BASIN (NW)	1947	6,795	MADISON (MISSISSIPPIAN)	Sinclair-Wyoming Oil Company's	Wilkins	1, Section 28-9s-23e.
NEW MEXICO	(NW) SAN JUAN	BARKER	1945	9,468	———— (PENNSYLVANIAN)	Southern Union Production Company's	Barker Dome	9, Section 21-32n-14w.
WYOMING	NATRONA	W. POISON SPIDER	1948	14,309	FRONTIER (U. CRETACEOUS)	Pure Oil Company's	Unit	1—NW SE/4 Sec. 11-33n-84w.



LOST SOLDIER AND WERTZ DOMES,
CARBON AND SWEETWATER COUNTIES, WYOMING

SCALE
0 1/2 MILE

Subsurface structural contour map of Little Lost Soldier and Wertz domes contoured on top of the Tensleep (Pennsylvania) sandstone at top and geologic cross-section from east to west at bottom. The arrow indicates the location of the Cambrian formation oil pay discovery, geologically the deepest for the Rocky Mountain province. (After Dobbin, Dramer, Swedenborg)



Aerial photograph of Elk Basin field, Wyoming and Montana. (Courtesy of Aero Exploration Co., Tulsa, Okla.

brian formation represented and consists of cliff-forming limestones.

Regionally, the pre-Cambrian rocks were reduced to base-level throughout the Rocky Mountain province and the Flathead sandstone was laid down unconformably upon their smooth but uneven surface.

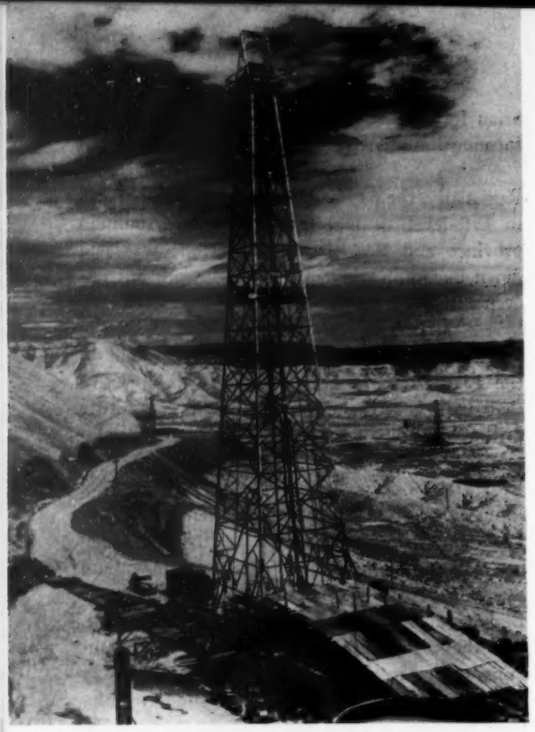
At Oregon basin, oil showings were found in the Flathead sandstone and it is this objective that will be watched with interest in future drilling development through the Rocky Mountain province where it is present.

The Ordovician in Wyoming and northern Colorado is represented by a relatively-thin deposit of limestone which attains a maximum thickness of 300 feet. The type locality for the Bighorn dolomite, the Ordovician representative, was the eastern slopes of the Bighorn Mountains where it was first described in 1904 by Darton. He pointed out that the Bighorn dolomite includes a basal white sandstone, a massive magnesian limestone and about 100 feet of softer thinner-bedded limestone at the top. From principally paleontologic evidence, age relationships range from Black River at the base, to late Richmond at the top, divided by a hiatus equivalent to later Trenton, Utica, Eden and Lorraine stages.

Branson and Branson (1941) show that in most of the Wind River Mountains, the Ordovician is represented by only one formation, the Bighorn dolomite; however, the Lander sandstone occurs in the central part of the Wind Rivers, and some geologists have tried to differentiate the Leigh dolomite in the range. The Bighorn dolomite forms a prominent line of cliffs in the walls of the canyons which stand as buttresses above the Cambrian slopes at the top of the dip slopes. Its lithology may be described as a massive light buff dolomite which weathers irregularly to a rough, pitted surface. Blackwelder (1913) explains the irregular weathering as due to differences in texture. From a maximum thickness of 300 feet in the northern part of the range, it thins to about 200 feet at Fossil Hill, and disappears within a distance of 25 miles to the southeast.

In the Gros Ventre and Teton ranges, the Bighorn dolomite may include more than one formation and only part of the strata may be equivalent to the Bighorn formation farther east at the type locality.

Age determinations of the Bighorn dolomite are uncertain. In the Gros Ventre range, Blackwelder collected a small fauna from the Bighorn which was considered by Urich as Upper Ordovician. However, Weller and Kindle assigned it to the middle Silurian. Arthrodire plates, correlated by Gregory as Devonian, were found in the Leigh member of the Bighorn. Thus it may appear that a portion of the Bighorn may be



Photograph courtesy Continental Oil Co.

Devonian in age; possibly a portion may even be Silurian.

The Bighorn dolomite has not yet been found to be productive of oil or gas in wells. On the outcrop an oil odor may be discernible from freshly-fractured samples.

Generally, the Cambrian, or the Ordovician where present, is succeeded by the Carboniferous in southwestern Montana and western Wyoming; but the Jefferson (Devonian) limestone intervenes in some sections and is underlain by strata which is inferred to be Silurian from the conformable sequence. Kindle (1908) assigns possible Silurian age to a portion of a section of 700 feet of gray limestone found below the saccharoidal limestones of the Jefferson in a section near Viola, Wyoming and for a lower Paleozoic section 20 miles south of Princeton, Montana.

A correlation chart of the Devonian system of the Rocky Mountain region appears elsewhere in this article. Published under the auspices of the Geological Society of America, it represents the work of G. A. Cooper and Edwin Kirk with the assistance of C. W. Merriam.

Rocks of lower Devonian age are virtually unknown over most of the Rocky Mountain province except for the Beartooth Butte limestone of northeastern Utah which has been assigned a late Ulsterian age. Rocks of Erian age are not known and the next representative in the Devonian system is the Jefferson limestone which has been correlated as the Finger Lakes stage of the Senecan series. It has been found in northwest Montana and Idaho. The formation is known for about 425 miles from north to south and about 150 miles from east to west in Montana. Its distribution in Montana has been noted by Kindle as generally coinciding with that of the Madison limestone which immediately follows it in the sections where the highest formations of the Devonian system are absent.

Succeeding the Jefferson in the western Rockies is the Darby formation which is correlated with the Chemung or upper stage of the Senecan series. The type locality of the Darby formation is Darby Creek on the west side of the Teton Range in Wyoming. Named by Blackwelder, it is described as present over most of northwestern Wyoming and recognizable as far to the southwest as the Wasatch Range in northeastern Utah. Blackwelder correlates the formation with the Three Forks shale and the upper part of the Jefferson limestone which were described by Peale (1893).

In the Gros Ventre and Teton areas, the Darby formation attains a thickness of 330 feet but thins rapidly to the east, disappearing on the east side of the Wind River Mountains.

In southeastern Idaho, Devonian rocks attaining a thickness of more than 1,100 feet have been described by Ross (1937). In southwestern Wyoming at Labarge Mountain, rocks of Devonian age exceed 1,000 feet in thickness.

The brownish Darby limestones may be contrasted with the typically gray-colored Madison limestones of lower Mississippian age which in places overlies the Devonian Darby formation. In southwestern Montana, the Three Forks shale of the Chautauquan series overlies the Darby formation. A variety of fossils found in the Three Forks shale suggest affinity with the Percha shale of New Mexico and the Ouray limestone of Colorado. (The Ouray limestone is productive of gas on the Tocito dome in the San Juan basin of northwestern New Mexico at a depth of 6,659 feet).

In describing the lithology of the Three Forks formation in the New World or Cooke City mining district of Park County, Montana, Lovering (1929) states that the upper half is bright-red and green fissile shale and thin-bedded purple limestone and that the lower half contains gray and purple limestone, light-brown sandy limestone, shaly limestone and gray and purple shale.

In northeastern Utah, a zone of dark shale lying between the Jefferson and the Mississippian Madison is definitely proven by paleontologic evidence to be not Threeforks shale in age; however it is carried in quotation marks as Threeforks on the Devonian correlation chart, and is tentatively assigned a Conewango stage age.

Prior to the Laramide revolution, the Bighorn basin of northeastern Wyoming was neither a structural basin nor a sedimentary basin; but constituted a small part of a vast platform area inundated repeatedly by epicontinental seas.* The transition from the Paleozoic to the Mesozoic eras in western Wyoming was marked by crustal stability with but slight break in sedimentation. The pre-Cambrian structural pattern of this part of the province continued with but little change into the Mesozoic.

Five geologic events influenced the sedimentary history of the Greenhorn and Bighorn basins during Mesozoic time:

(1) The Cordilleran Geosyncline. From the western seaway the epicontinental seas moved eastward during Dinwoody, Gypsum Springs, Lower Sundance and Upper Sundance time.

(2) The Nevadian Revolution in Idaho. Near the close of Jurassic time, the intrusion of the Idaho batholith raised highlands west of the Bighorn basin, changed the Cordilleran trough, and created clastics which were moved to the east; these were deposited in the Cloverly (lower Cretaceous) and the Morrison (Upper Jurassic) formations.

(3) The Expansion of the Upper Cretaceous Sea. The Great Plains area which extended from the Arctic to New Mexico received extensive marine black shales with some sandstones and limestones.

(4) The Laramide Revolution. The time of the major structural event of the Rocky Mountain province, is not restricted to a limited small geologic period. As early as Montana (middle upper Cretaceous) time, initial phases of the Laramide orgeny were under way in Nevada and central Utah; subsequent activity took place until the close of the Eocene.

(5) Withdrawal of the Cretaceous Sea. The upper Cretaceous sea withdrew from the great plains region over a vast area.

A long period of crustal stability followed during which a great thickness of rocks was eroded.** By Oligocene time the region was reduced to a surface of moderate relief. During Oligocene and Miocene time, drainage became sluggish or ponded, chiefly due to slow, crustal movements which outlined the present ranges and basins.

Areas corresponding to the present basins became depressed; in these the Tertiary lake beds accumulated over relatively large areas. Areas of uplift which corresponded to the present mountains were eroded and furnished volcanic ash and detritus to the lake beds.

In late Miocene or early Pliocene time, the surface comprised areas of older rocks that had been eroded to slight or moderate relief, except for scattered residual ridges and peaks; and areas of the lake beds which formed gently sloping or level plains. This surface is known a the Late Tertiary Peneplain except for the residuals.

Deposition of the lake beds and further levelling of the older rock areas was interrupted by re-elevation accompanied by greatly intensified local crustal movements that relatively raised the present mountains. These movements continued intermittently but with decreasing intensity throughout the Pliocene; except for small displacements as late as the Recent epoch, these ceased in early or middle Pleistocene. This phase is thought to constitute a distinct late stage of Cenozoic mountain building.

* G. R. Downs, "Guidebook, Field Conference in the Bighorn Basin, 1947."

** J. T. Pardee, Abst, Bull. Geol. Soc. Am. Vol. 58, No. 12 Pt. 2, December, 1947.

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International News and Notes

Dr. Guillermo Zuloaga

DR. GUILLERMO ZULOAGA, head of the geological department of Creole Petroleum Corporation since 1945, has been made a member of the management committee. In his new position he will be responsible for the policies of the geological and public relations departments of the company.

Dr. Zuloaga graduated in 1924 from the Central University of Venezuela in Caracas, and obtained the Ph.D. in geology in 1930 at the Massachusetts Institute of Technology. Following graduation he was appointed petroleum inspector in Maracaibo and in 1931 became Venezuela's chief petroleum inspector with headquarters in Caracas. In 1936 he helped to found the Servicio Técnico de Geología y Minería del Ministerio de Fomento and was a member of its executive board. He remained with the government until 1939 when he began work as assistant chief geologist for the Creole Petroleum Corporation. In 1945 he became chief geologist, a position he held until the recent appointment to the management.

W. E. Wallis, a geologist with 18 years of experience in Mexico, Egypt, Costa Rica, Cuba, Ecuador, and Peru, has been named to succeed Dr. Zuloaga as chief geologist, and W. E. Franks of Creole's geophysical department will assume Mr. Wallis's former duties as assistant chief geologist.

British Plan Carbon Black Industry

The Palatine Development Co. has obtained from Phillips Petroleum Co. the rights to manufacture two types of carbon black in Britain. Building of a £1,000,000 factory on a 20-acre site at Avonmouth, Bristol, is expected to start this year. American technicians have already visited Bristol to discuss construction of the plant.

Gas Consolidated and Severn Gas Corp. jointly own the capital of Palatine Development Co. Negotiations to increase the present capital are being conducted. Meanwhile, United Carbon Black has been registered as a private company with a capital of £125,000. It will carry on the business of manufacturing chemists with the production of carbon black as its main interest.

Italian Refinery Breaks Records

In August, 1948, "Aquila" broke all pre- and post-war production records with a crude oil input of over 54,000 tons during the 31 days of the month at its Trieste refinery. Although the refinery was almost completely destroyed by the Allied bombing during the war, it has subsequently been rebuilt in a little more than eight months, and since restarting operations in June, 1947, the distillation plant has processed an aggregate of 500,000 tons of crude oil.

The South African motor tanker "President Brand" of 17,220 tons recently discharged at Aquila a cargo of 15,000 tons of naphtha from Arabia in the record time of 37 hours, 30 minutes.

W. G. WESTON has been appointed joint general manager with R. J. E. Dodds of the marine department of Anglo-Saxon Petroleum Co., London. Mr. Weston formerly was deputy secretary of the Ministry of Transport.

FRANK G. HALL has been elected a Vice-President of Imperial Oil Limited. Mr. Hall joined Imperial Oil as an office boy in 1912. After wide experience in the marketing department he became assistant general sales manager in 1935. Subsequently, in addition to his regular work, he took over the duties of co-ordinator of sales and vice-chairman of the marketing department. In 1945 he became general sales manager and a year later was elected a director. During the war he served on a number of advisory committees which assisted the oil controller in supplying petroleum products for Canada's war effort.

George Randolph Ferguson

GEORGE RANDOLPH FERGUSON has been appointed assistant vice president of California Texas Oil Co., Ltd., supply and distribution department. He formerly was manager in New York of the Australasian division of Caltex. Mr. Ferguson went to Australia for The Texas Co. in 1930. During his 12 years there he became assistant general manager of Caltex operations in that country. From 1942 to 1946 he was on leave of absence with E. B. Badger and Sons Co., as project engineer to handle design of synthetic rubber and aviation gasoline plants and sea water distillation equipment for the armed services.

Chemical Centrifuge

A stainless steel laboratory basket centrifuge has been developed by Measuring and Scientific Equipment, Ltd., London, for research workers. The centrifuge consists of a motor base, detachable draining chamber and five-inch diameter basket which also is detachable. Speed of operation may be advanced through seven steps to a maximum of 4,000 rpm. Spring clips are provided for easy application of filter cloth over the entire perforated area of the basket. The company also is featuring a motor-driven "Ato-Mix" for mixing, emulsifying and other time-wasting laboratory processes.

LT. GEN. SIR W. G. LINDSELL has been elected chairman of the board of Petrochemicals Limited to succeed Mr. H. Stuart Ebben. Mr. Ebben has been chairman of Manchester Oil Refinery Ltd. since its inception in 1938 and retains his seat on the board of Petrochemicals Ltd.

General Lindsell served with distinction in both World Wars. During 1942-3 as lieutenant general in charge of administration in the Middle East under General Montgomery, he was responsible for the development of the Middle East base and the supply and maintenance of the 8th and 9th Armies, including the maintenance of the 8th Army from El Alamein to Tunis and Sicily. After his retirement from the army in 1945, he was appointed chairman of the Disposal Board, being responsible for organizing the disposal of £10,000,000 worth of government surplus stores. He joined the boards of Manchester Oil Refinery Ltd., Petrocarbon Ltd., and Petrochemicals Ltd., in 1946.

Emsco-Continental Men on Latin American Trip

K. F. Forsyth, manager of California and export sales for Emsco Derrick & Equipment Co., Los Angeles, and Julio Zumeta, executive manager of exports for The Continental Supply Co., Inc., recently left for an extended field trip through the Latin American oil fields. Their first ports of call will be Venezuela, Colombia and Mexico.

During the past few months Emsco Derrick & Equipment Company has sold considerable drilling equipment in South America and Mexico. The purpose of their visit is to study Latin American oil field operations and to determine the drilling and production equipment requirements in these areas. The Continental Supply Co., Inc., of New York, is the exclusive distributor for Emsco-D-B drilling and production equipment.

Iranian Production

Production of crude oil in Iran during the month of July was 2,283,00 tons, an average of approximately 567,000 barrels daily. From Jan. 1 to July 31, production totaled 13,759,000 tons, an average of 497,000 barrels daily.

Forms Canadian Subsidiary

Sunray Oil Corp. has organized a wholly-owned subsidiary to prospect for and to produce oil in Alberta, Canada. The new company has established a resident agent at Edmonton, Alberta, and will probably have an office at Calgary.

Venezuelan Production

Production of crude oil in Venezuela during the month of August amounted to 42,220,936 barrels, an average of 1,361,966 barrels daily. As compared with July, this daily average is higher by 13,110 barrels. Exports for the month were 37,546,564 barrels. Production by companies is shown in the following table:

Company	West	East	Total
Creole	15,214,483	5,007,600	20,222,083
Mene Grande	1,830,811	4,940,226	6,771,037
Shell	13,033,707	—	13,033,707
Sinclair	—	564,298	564,298
Socony	—	930,068	930,068
Texas	—	281,276	281,276
S.A.P. Las Mercedes	—	320,014	320,014
B. C. O.	31,686	—	31,686
Orinoco	8,470	—	8,470
Phillips	—	53,293	53,293
Rexco	—	—	—
Atlantic	—	5,004	5,004
Total barrels	30,119,157	12,101,779	42,220,936

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INTRODUCE NEW ANTI-DETONANT

Three Oil Companies Cooperate in Experimental Marketing of Alcohol-Water-TEL Injection Device Through Columbus Stations

AN experiment in marketing a new type knock suppressor is being conducted currently in Columbus, Ohio, by three oil companies. The experiment is taking place only a few miles from Dayton, where Ethyl gasoline was introduced to the public a quarter of a century ago, and is being advertised as the "greatest performance booster since tetraethyl lead."

The knock suppressor has been under development for eight years. It consists of a device known as the Vitameter, by means of which a mixture of alcohol, water and tetraethyl lead is introduced into the manifold of the motor when, and only when, added resistance to knocking is needed—on hills and during the acceleration period. When the anti-detonant mixture is being injected into the fuel-air stream, the fuel reaching the cylinders is improved by about 10-20 octane numbers, it is claimed.

Developer of the new device is the Thompson-Toledo Vitameter Corp. of Cleveland, an affiliate of Thompson Products, Inc., manufacturer of automotive devices. Introducers of the Vitameter in Columbus are The Pure Oil Co., Shell Oil Co. and Standard Oil Co. of Ohio. Sale is being confined to Columbus for the remainder of this year, after which it is planned to expand the operation throughout Ohio in 1949 and elsewhere as experience and demand may suggest.

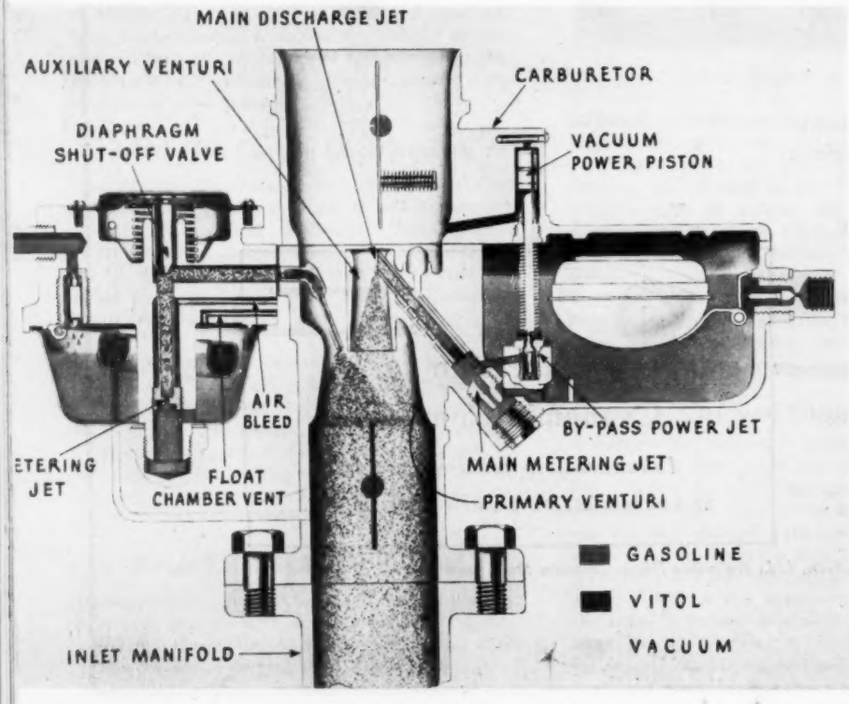
First offering to the public at Columbus was on Sept. 18. Within three days 3,300 units were sold to jobbers. By the first of October Thompson-Toledo had sold out its entire stock of Vitameters at the jobber level. Dealers had sold more than 1,500 to motorists and were out of models designed for the more expensive makes of cars. Units were available only for Chevrolet, Ford and similar low-priced cars. The demand was a surprise to the manufacturers, although they had gone all out in their preparations for the sale.

Some six weeks before the first unit was sold, Thompson-Toledo installed a Vitameter in the personal cars of service managers of the principal garages and car sales agencies in Columbus. Installation was made under supervision of the manufacturer. Before the public sale opened, the service managers were asked for endorsements. To make it easy for them, the manufacturers had had sample quotas prepared; one group enthusiastic, one group giving approval and a third noncommittal. To their surprise the service managers wanted to write their own and in every case were highly enthusiastic.

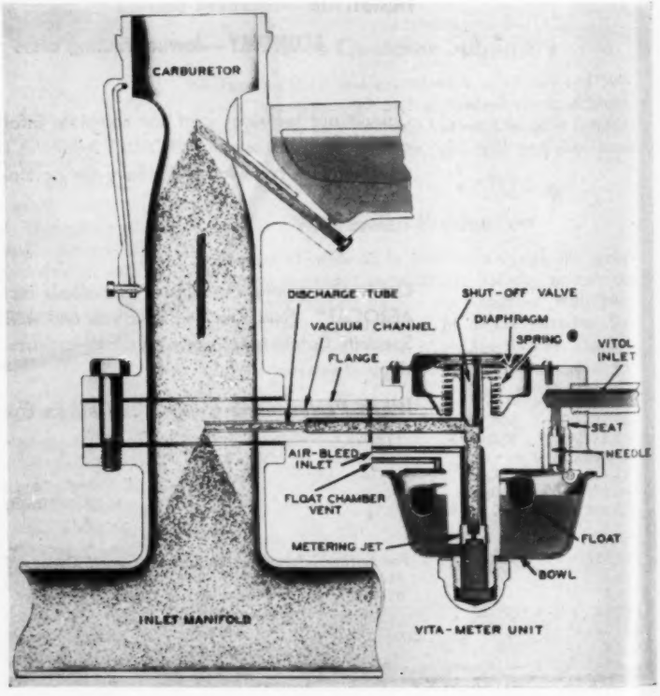
The actual sales in Columbus were opened with all the modern sales aids developed by the oil and automotive industries. Billboards were plastered with 24-sheet posters, station banners were hung. "A" boards invited the motorist in to see the unit on display. Both the Vitameters and the cans of anti-detonant known as Vitol were displayed on station islands and handouts telling the story in detail were passed out to every gasoline buyer at Columbus stations of Pure, Shell and Sohio.

Thompson-Toledo recognize, of course, that their gadget only will find universal use in cars if the motorcar manufacturers themselves adopt it. But they can't tell it to the motor manufacturers until the Vitol is universally distributed. It was for this reason that sale as an accessory was adopted. View of the manufacturers is that the Vitol should be sold by oil companies, and it is planned to permit the oil companies to blend Vitol ingredients and package it for sale through normal gasoline and oil distributing channels. The Vitameter itself does not lend itself to sale through most filling stations, since it requires removal of the carburetor, drilling of the firewall for Vitol tank supports and the installation of necessary plumbing without interfering with normal servicing operations. At Columbus units

Cross section of carburetor-mounted Vitameter.



Flange-mounted Vitameter of the type being sold in Columbus.



IN OHIO GASOLINE STATIONS

are on display at all stations of the three participating oil companies, but motorists are directed to garages or other general service establishments for installation.

Cost of a Vitameter installed on a car in Columbus is $34.00 including an initial fill of four quarts of Vitol, which sells at $1.20. The average car will use a gallon of Vitol for each 500 to 700 miles of travel, approximately two percent as much anti-detonant being injected as gasoline consumed. It is estimated by Thompson-Toledo that the cost of Vitol is on the order of 0.025 per octane number added to the fuel which is far less than octane number costs at the oil refinery above the range of premium grades of fuel.

The Vitameter was designed to take advantage of the fact that internal combustion engines require high octane fuel only at full throttle or thereabouts, so Vitol is injected only when needed. In a paper presented before the Society of Automotive Engineers earlier this year W. M. Holaday of Socony-Vacuum Oil Co., Inc., reported that an eight-cylinder, 1948 model passenger car requiring 80-octane gasoline at full throttle and low speeds in the 20-30 miles-per-hour range, will operate satisfactorily on 65 octane gasoline at full throttle and at 60 miles per hour. On level roads at part throttle the same car operated satisfactorily on motor fuel with octane testing as low as 15. Using 50-octane fuel Mr. Holaday found that his 7.0-1 compression ratio car gave knock-free performance 80 percent of the time on cross-country driving which included mountainous terrain, 87 percent of the time in city traffic and 95 percent of the time on a level dual highway.

To administer the anti-detonant only when needed, the Vitameter uses the intake manifold pressure as a controlling force. This makes injection entirely automatic as far as the driver is concerned. As shown in the accompanying cross section, the Vitameter is mounted between the carburetor and the inlet manifold. Vitol is contained in a float bowl from which it is not allowed to flow by a shut-off valve which is held in the closed position by the high manifold vacuum at idle and part throttle. At full throttle the force of the diaphragm spring overcomes the force exerted by the low manifold vacuum, the valve opens and Vitol flows into the air-fuel stream. The amount of Vitol injected is controlled by the size jet used. The point at which injection occurs is controlled by the spring tension.

During World War II alcohol-water mixtures were injected into the motors of fighter planes both for the cooling and supercharging effect, and to increase the octane rating of the fuel. An increase in speed of about 30 miles per hour was achieved by injecting appropriate quantities of 50-50 alcohol-water mixtures. In their experiments with ground vehicles Thompson-Toledo found that the cooling effect of water was not needed and that the optimum mixture was 85 percent alcohol and 15 percent water plus tetraethyl lead.

Sponsors suggest that the Vitameter can be used in either of two ways. It can be used with lower octane gasolines to reach commercial levels, or it can be used with regular or premium grade gasolines to give satisfactory performance on higher compression ratio cars of the future or present cars which knock at best spark settings. In the Columbus marketing experiment the latter attack is being made, but experiments also have been conducted on fleet operations where low-octane, straight run gasoline has been used as fuel.

At Cleveland, Ohio, a fleet of Yellow cabs has been operated some two million miles on 63-octane gasoline consisting of 58-octane straight run plus 0.5 cc of TEL per gallon. Included in the fleet used in the experiment were 65 Plymouths which give good operation on 75-76 octane gasoline (motor method) and 23 airport limousines requiring 81-83 octane gasoline. Both have been using the 63-octane fuel plus Vitol. Jets in the limousines are of such size that enough Vitol is injected to give the equivalent of premium gasoline performance.

At first the cabs tried 58-octane clear gasoline but found Vitol consumption was about 4.4 percent of gasoline. By adding 0.5 cc of lead to the gasoline and bringing the octane level to 63, the Vitol consumption was lowered to 2.8 percent. On this fleet operation the lower cost of the straight run gasoline made the operation profitable, but after some months it was found that maintenance costs also were lowered. Formerly every cab was given a major overhaul at 60,000 miles and was sold at 120,000 miles. When mileage intervals suggested overhauls recently, however, the garage reported that overhauling was not necessary and cars were put back into service. Now the company hopes to get a full 120,000 miles without an overhaul.

To test collateral results four new cabs were put on Vitol last June and four on regular gasoline. Each engine was torn down and all moving engine parts weighed and measured before being put into service. Recently the units were taken out of service after 23,000 to 27,000 miles of operation and again torn down. Inspection revealed that oil inlet screens on the cabs using regular house-brand gasoline were 98 percent plugged compared with only 10 percent plugging on the Vitol fueled cars. Cylinder and ring wear was 50 percent more on the cars using regular fuel.

While the fleet test results on low octane gasoline have been spectacular, Thompson-Toledo pins its hopes for real future success on application to higher compression cars of the future. Automobile manufacturers are testing the device on various types of motors, and meanwhile the company hopes to get enough units installed by present car owners to make it worth while for oil companies to build a nationwide distribution for Vitol so that the motor manufacturers will not be hesitant in equipping cars with Vitameters at the factory.

Typical passenger car installation showing five-quart tank for Vitol supply and the flange mounted Vitameter installed below the carburetor.

OIL COMPANY STAFF CHANGES

James G. Craig

JAMES G. CRAIG has been appointed superintendent in charge of Continental Oil Co.'s drilling developments off the coasts of Louisiana, Texas and California. Continental, Atlantic Refining Co., Cities Service Co. and Tidewater Associated Oil Co. have spent $1,703,000 for leases in the Gulf of Mexico where the group now holds approximately 347,000 acres. Continental also is engaged with other firms in a partnership project doing sub-sea charting off the coast of California.

CLARK H. KOUNTZ, vice president in charge of pipelines for Sinclair Refining Company, has retired after 47 years in the oil industry. He started as a messenger boy with the Ohio Oil Co. in 1901 and in 1905 joined the Prairie Oil & Gas Co. as secretary to vice president and general manager, James E. O'Neil. In 1906 he was made assistant secretary and in 1910 was elected secretary and made a director of Prairie. In 1915 he was elected vice president of the then newly-organized Prairie Pipe Line Co. which position he held until the merger of the Prairie Oil & Gas Co. and Prairie Pipe Line Co. with the Sinclair Oil Corp., when he became chairman of the board of the Sinclair Prairie Pipe Line Co. In 1936 when Sinclair Refining Co. took over pipeline operations, he was elected vice president, which position he held until retirement.

H. D. HOBSON has been appointed supervisor of exploration for California operations of the General Petroleum Corp., it is announced by C. M. Wagner, director of exploration of the company. Mr. Hobson has been acting supervisor since last May and has been making his headquarters at Bakersfield. In his new post he will be at the home office in Los Angeles. He joined General Petroleum in 1940 as a senior geologist in the San Joaquin Valley.

A. H. P. GORE has retired as manager of the pipeline department of Richfield Oil Corp., Los Angeles. He is succeeded by Norman Anderson. D. F. Purdy has been promoted to chief engineer.

DAVID B. BURROWS of Tulsa, has been appointed senior research engineer of Continental Oil Co.'s production research laboratory. He will be in charge of the fluid hydrocarbon section which will make all analysis on bottom hole samples and condensate wells. Mr. Burrows has been engaged for several years in reservoir engineering work.

H. W. Ross

H. W. ROSS has been executive assistant to J. Frank Wilson, St. Louis, vice president of Sohio Petroleum Co. and Standard Oil Co. (Ohio), and has opened offices in Tulsa, Okla. Duties of Mr. Ross will include coordination and liaison between the crude oil purchasing department and top operating management of the production department. Mr. Ross was for many years with The Texas Co. in charge of the drilling and production departments in the eastern states and Oklahoma, and in recent years was connected with Dowell Inc., as sales manager of the industrial division.

FRANCIS A. LECATES has been appointed general auditor of Sun Oil Co. He succeeds Walter K. Smith who has resigned after 22 years of service with Sun. Mr. LeCates joined Sun as an auditor in 1929.

J. L. CAHILL of Tulsa, designer of precision instruments and inventor of a hardening process for stainless steel, has been appointed chief engineer of Continental Pipe Line Co., Ponca City, Okla. During the war Mr. Cahill assisted the Sea Bee program by designing portable equipment for overseas shops and power tools for use under battle conditions. He helped to develop the 20mm anti-aircraft cannon for the Bureau of Ordnance and did special work for the Bureau of Ships. Recently he served as design and sales engineer for the Diesel Power Co.

J. L. Cahill

JAMES WATSON has joined the Oil States Petroleum Co., New York, as Assistant to the President, Charles T. Faas. Mr. Watson was formerly comptroller of the Bishop Enterprises, Summit, N. J. Oil States Petroleum Co. is a manufacturer and exporter of white mineral oils, petrolatums, waxes and other petroleum derivatives.

H. S. McCLINTOCK has resigned as a vice president of Sunray Oil Corporation to become an independent consultant in land, leasing and production operations. Mr. McClintock joined the Sunray organization in 1937 as manager of the company's land and geological departments. He became a vice president in 1940.

DR. ROBERT E. WILSON, Chicago, chairman of the Standard Oil Co. (Ind.), has been named chairman of the committee on research of the board of directors of the American Petroleum Institute. He succeeds the late Harry Weiss.

CLAUDE E. SWIFT has been elected vice president of Union Oil Co. in charge of research and patents. He formerly was patent counsel and manager of research. Mr. Swift joined the company as an inspector in 1926 and became a junior chemist in 1927.

R. L. JOHNSON has been appointed manager of Sunray Oil Corporation's catalytic cracking refinery at Duncan, Okla. He had been superintendent of the Duncan plant since August, 1947, and succeeds W. D. Manz, resigned.

J. R. MULVEY, assistant comptroller of the Humble Oil & Refining Company, Houston, has been elected a vice president of the Controllers Institute of America, and James C. Anderson, comptroller of the Standard Oil Co. (N. J.), New York, has been named a director. The elections took place at the Institute's 17th annual meeting, held Oct. 10-14, in New York.

DR. WAYNE E. KUHN, manager of the technical and research division of The Texas Co., New York, has been elected chairman of the division of petroleum chemistry of the American Chemical Society for 1948-49. He succeeds Dr. Gustav Egloff, director of research of the Universal Oil Products Co., Chicago. Dr. Arlie A. O'Kelly, associate director of research of the Socony-Vacuum Oil Co., Paulsboro, N. J., was named vice chairman, and Chalmer H. Kirkbride, laboratory director of the Houdry Process Corp., Marcus Hook, Pa., was reelected secretary-treasurer.

Dr. Bernard H. Shoemaker, assistant research director of the Standard Oil Co. of Indiana, Whiting, Ind., and L. U. Franklin, assistant chief chemist of the Gulf Oil Corp., Port Arthur, Texas, were chosen members of the executive committee of the division.

Wayne Kuhn

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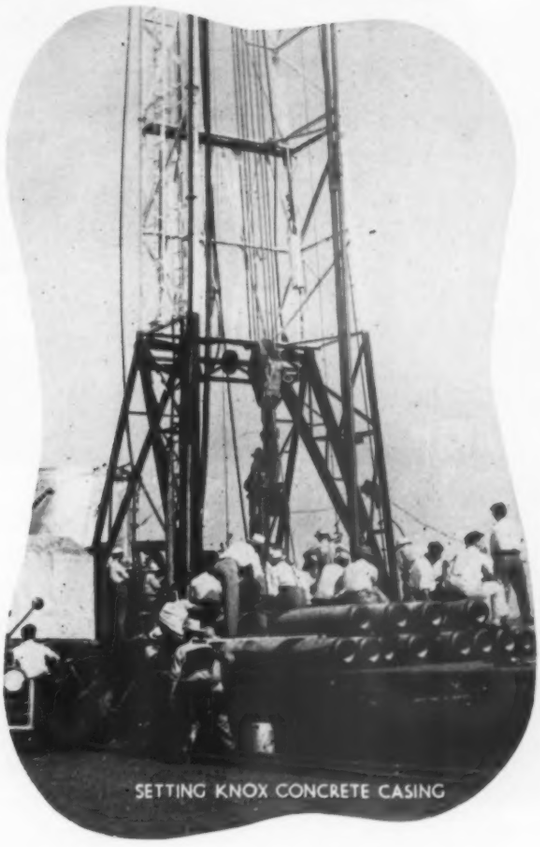

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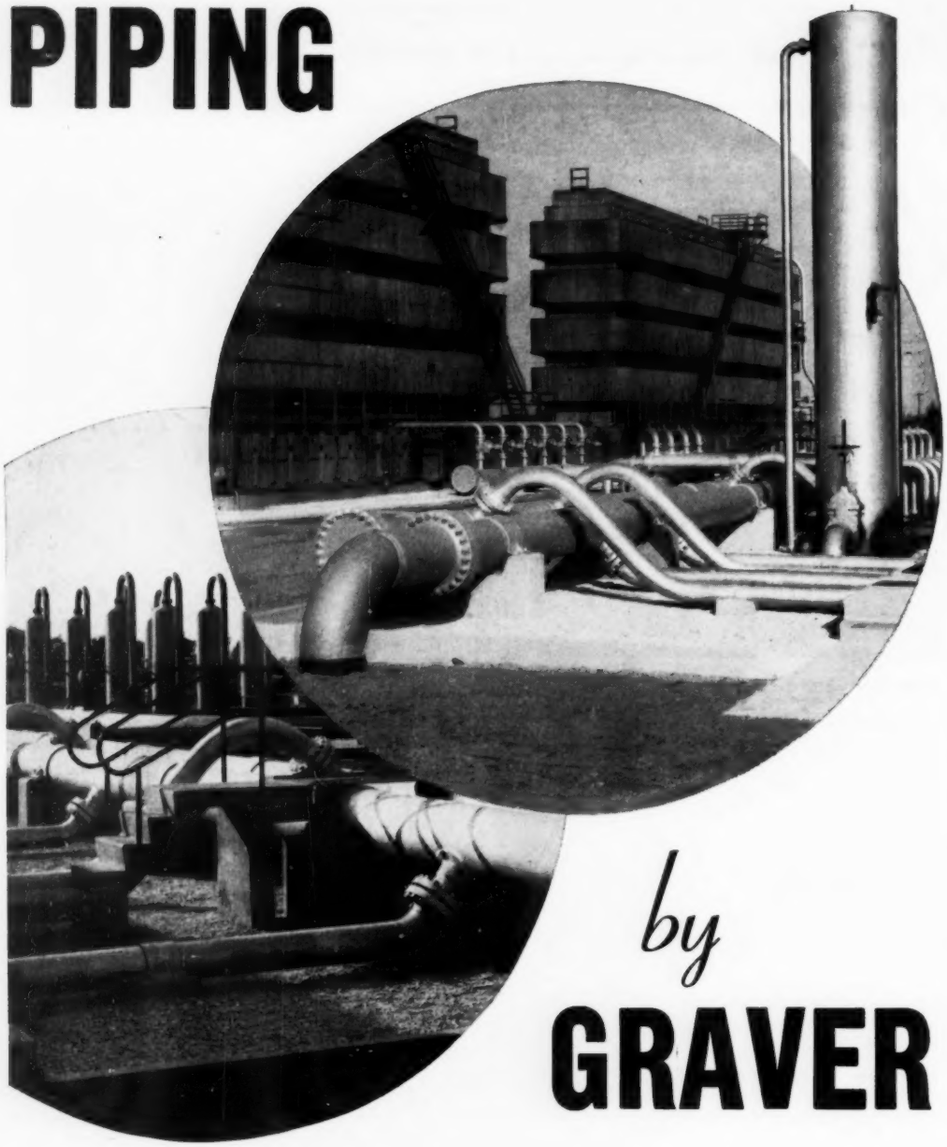

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Heads Ethyl Chemical Sales

Harry Kuhe, who has been with Ethyl Corp. for 19 years, has been appointed manager of the chemical sales division, a new post with the company. He will be in charge of sales of chemicals, except "Ethyl" antiknock compound, now being manufactured at the company's plant in Baton Rouge, La. As operations manager in the central region, Mr. Kuhe has been succeeded at Chicago by Leonard L. Huxtable, formerly sales coordinator in the southern region.

Chemical products which Ethyl Corp. has been selling in recent years include salt cake (sodium sulfate), liquid chlorine, metallic sodium, ethylene dichloride and oil soluble dyes. Recently the company added benzene hexachloride to the list for sales to insecticide manufacturers.

Colombian Oil Consumption

Demand for petroleum products in 1947 was twice as great as in 1946 according to data recently presented to the Colombian Senate oil committee by the National Petroleum Council. Total in 1947 was 240 million gallons compared with 124.5 million gallons in 1946 and 97.6 million in 1939.

Motor fuel demand in 1947 was 88 million gallons compared with 66 million in 1946 and 39 million in 1939. Fuel oil showed a tremendous increase from 30 million gallons in 1946 to 117 million gallons in 1947. Diesel oil demand was up 3.7 million gallons to 16 million, and kerosene 800,000 gallons to eight million.

To keep pace with the enlarged demand, the Colombian Senate has approved a bill to erect a government refinery at Cartagena or to enlarge the Barranca plant. Approval also has been given to the laying of a products pipeline from La Dorada to Cartago and for the survey of another products line from Pto. Salgar to Bogota.

Elects New President

Parker F. Wilson, well-known steel executive, was elected president and director of the Kerotest Manufacturing Co. at a recent meeting of the board of directors. Former president Walter G. Swaney was named vice chairman of the board. Mr. Wilson has served in various executive capacities with Otis Steel Co., Wheeling Steel Corp., and more recently as president of Pittsburgh Steel Foundry Corp.

New District Manager in Western Canada

R. M. Cook, vice president of Security Engineering Co., Inc., Whittier, Calif., announces the transfer of Arthur Nelson to Edmonton, Alberta, Canada, where he will serve as district manager. Mr. Nelson was formerly sales and service representative in Ventura, Calif.

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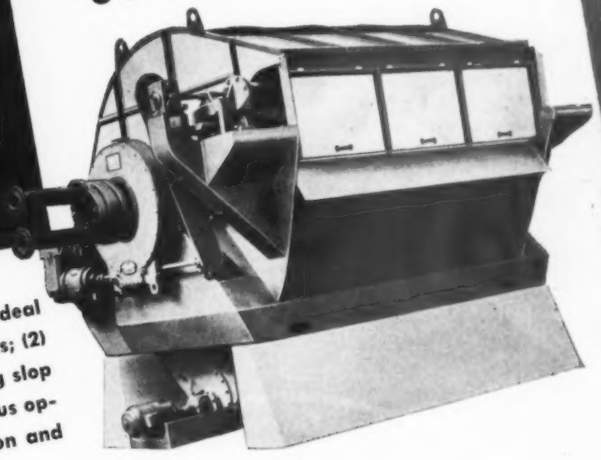

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Oil Supply for National Security

(Continued from page 77)

in the oil industry and in Washington are convinced. Some oil executives say the plan could never get to first base unless the industry were declared a public utility, and sweeping powers such as those exercised over natural gas and electric light companies were invoked. Others say the states could handle essential features of the plan if they were willing to cooperate.

While the subject of oiling military operation in a possible future war is paramount, oil men are concerned at the moment with another phase of the problem. This is the day-to-day and month-to-month task of supplying about 120,000,00 barrels of petroleum annually which the peacetime military machine is asking.

Less than five percent of total United States production, these demands are being met by the industry in full, but the job is tougher than it might seem. For avgas, about one-third of military requirements, the industry has to squeeze its refineries. Leaders are admitting the day is near when additional avgas refining capacity must be built. The rigid specifications of the military make the task harder. The military wants 10 percent aromatics. For certain aircraft it wants 115/145 octane, and to produce this takes twice the capacity required to produce avgas of a lower octane, say for a commercial airplane. Even for regular motor fuel much of the military requirement calls for premium gasoline. At times the industry has asked the military to lower its specifications, but generally in vain.

Thus, in the immediate future, avgas and jet fuel promise to be the tough supply jobs for the industry, just as they promise to be the tough ones in any war.

To supply the military, the voluntary allocations agreements plan in effect promises the government first call. The plan enables the industry to agree about ways to meet overall shortages. Some refiners claim they are giving more than their share of product to the military. This will always be true because of the large percentage of military requirements that are for cargo lifting and the unequal areal distribution of their demand. Coastal areas are hardest hit.

Because of slowness of offers, Interior Secretary J. A. Krug in September of last year wrote 50-odd large refiners (over 10,000 barrels daily capacity) and suggested how much each should supply the military. And last July there were sharper warnings.

Top military procurement officers notified the National Petroleum Council in guarded terms that they had the power to take any oil they needed and negotiate about prices afterwards. The power is in the recent draft act. The officers explained they hoped they would not have to use the power but said they were ready to do so whenever requirements were not met promptly and fully by bids from the industry. They said the industry was given two months to bid on motor gas but had not made a single offer. They said the military had done its share to cooperate with the industry by giving advance notice of its demands and putting the bulk of its buying into a single agency.

A small shortage can start a whirlwind. There was a deficiency of one percent or less in heating oil supply last winter. It sparked one of the greatest threats of federal controls the oil industry ever faced. One of the more severe proposals was the Heselton Bill (by Rep. John Heselton, R., Mass.,) to set up a National Petroleum Commission for widespread regulation of the industry.

Likewise any deficit in supply for the military right now and any deficit expected for the future could touch off another drive for federal controls. Most of the Congressmen who would vote for controls might not want them, but might be moved by a widespread demand for action. When it comes back in January, Congress is sure to talk about the oil industry and probably about the staff report. How far it will go in the direction of specific legislation may depend upon the state of relations with Russia and whether the industry can come up with a better plan of its own to be carried out voluntarily.

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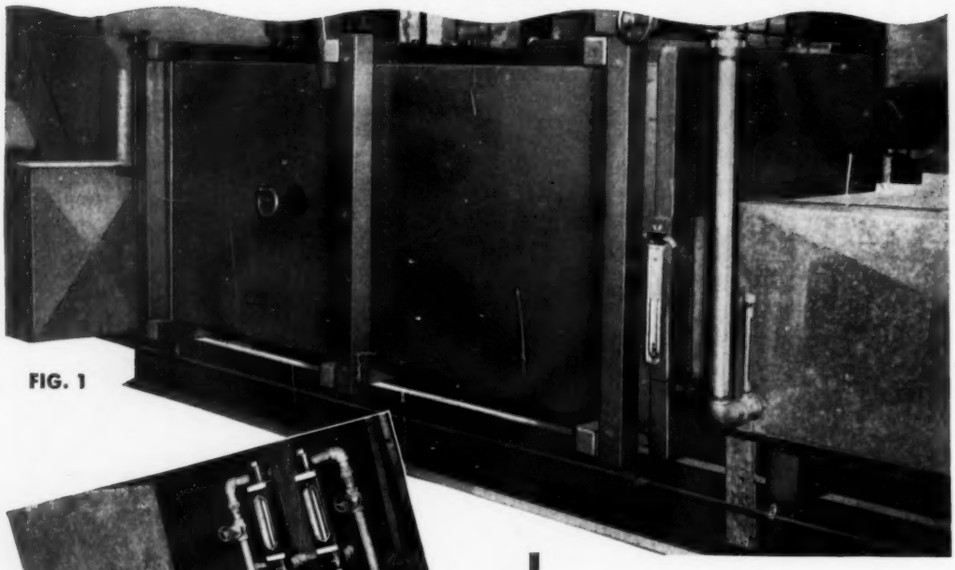

FIG. 1

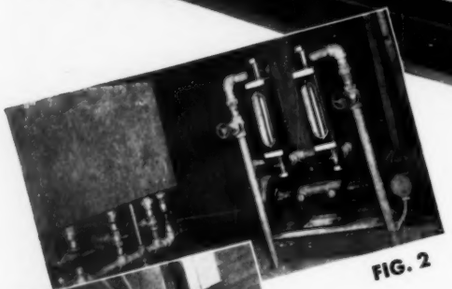

FIG. 2

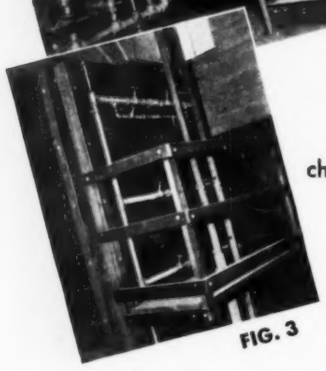

FIG. 3

* FIG. 1 Pre-conditioning chamber holds air characteristics constant during tests minimizing variables.

FIG. 2 Water metering station on full sized test tower.

FIG. 3 Headers provided at different levels to extend scope of test data.

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W. Alton Jones, president of Cities Service Co., holds the citation for "outstanding public service in the promotion of knowledge of and interest in the Bill of Rights" which was presented to him at a recent ceremony in observance of the 159th anniversary of the enactment of the Bill of Rights. With him is Messmore Kendall, president of the Bill of Rights Commemorative Society.

To Install Houdriflow Unit

The Petco Corp. will install a Houdriflow catalytic cracking unit at its Blue Island, Ill., refinery. The new Houdriflow process is an improved design of the Thermofor catalytic cracking (TCC) process which was originally developed by the Socony-Vacuum Oil Co. One of the outstanding changes in the process is its employment of a gas lift for circulating the catalyst instead of the previously used mechanical elevators.

The Houdriflow unit is designed to charge 5,000 barrels daily. Construction of the plant will be carried out to utilize as much of the existing thermal cracking plant equipment as possible, since the latter operation will be discontinued when the Houdriflow unit starts operation. Clark's Construction and Engineering Co. of Milwaukee is the contractor.

Pushing Product Line Completion

Two new products pipelines being constructed by Socony-Vacuum Oil Co., Inc., one from Malvern, Pa., to Binghamton, N. Y., and the other from Portland to Bangor, Maine, will be completed by Dec. 1. To hasten the work, Socony-Vacuum recently added a crew of 200 men to each pipeline in addition to the 200 who have been working on each line.

The 154-mile Malvern-Binghamton eight-inch line will deliver products from Paulsboro, N. J., to upper New York State. The 124-mile Maine pipeline will be the first in the state to carry finished petroleum products to inland terminals from Portland.

Heads Industrial Chemical Division

American Cyanamid Company announces the appointment of Arthur J. Campbell as division manager of the industrial chemicals division. Mr. Campbell, who was formerly general sales manager of this division, has been with the company for many years and has a wide range of experience in all of the fields serviced by this division. Under Mr. Campbell's supervision the industrial chemicals division produces and sells synthetic organic chemicals, petroleum catalysts and additives, heavy chemicals, paper chemicals, organic acids and plasticizers and other products which are widely used by industry.

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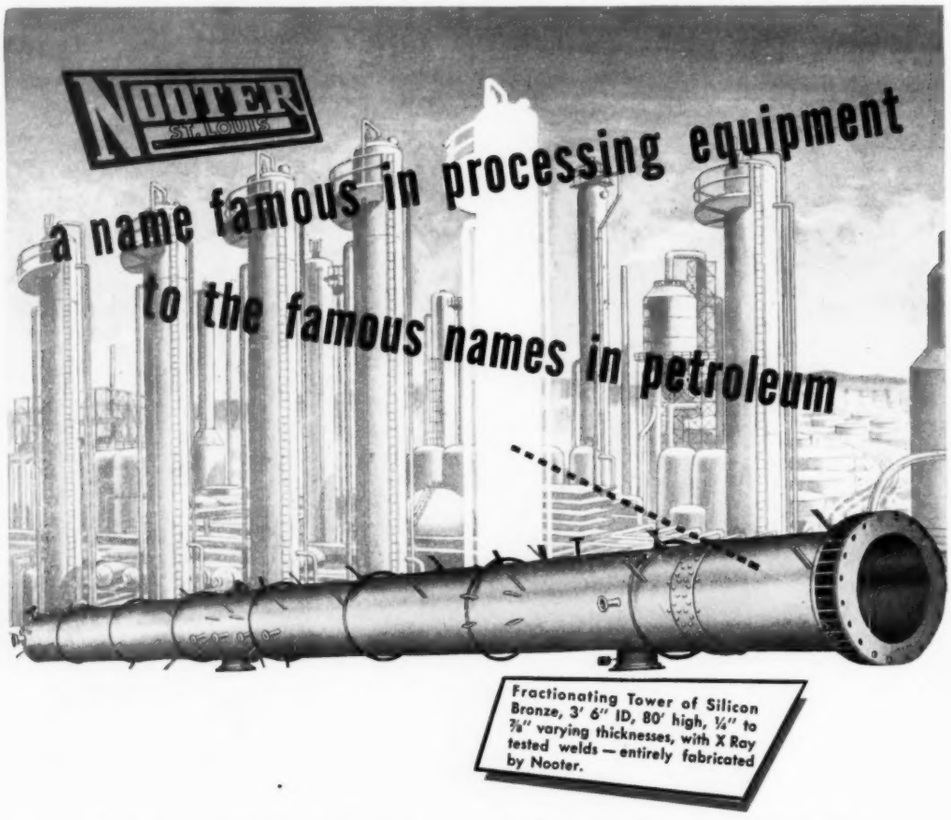
Phillips Builds Chemical Plant

Phillips Chemical Company, subsidiary of Phillips Petroleum Company, has purchased from the War Assets Administration the Todd Shipyard property on the Houston Ship Channel for use as a chemical plant site. Construction of the first chemical unit will be started immediately. This has been designed to produce 266,000 tons per year of ammonium sulfate. Because of the facilities already available on the 338-acre site, half the plant's capacity will be in operation before December 1, 1948, and total capacity will be reached early in 1949. The contractor employed for the ammonium sulfate plant is Chemical Construction Corp., while dock and marine work will be done by Brown and Root, Inc.

The plant's entire production of ammonium sulfate has been contracted to the Army until June 30, 1949. Anhydrous ammonia will be supplied to the sulfate plant from the Cactus Ordnance Works near Etter in the Texas Panhandle. Capacity of this plant, which now produces 200 tons of ammonia per day, is being doubled. In addition to the sulfate plant, property will be used for shipment of material and supplies used in Phillips foreign activities and drilling operations in Gulf coastal waters. The port facilities will be operated in conjunction with the nearby petroleum products terminal which Phillips now owns on the ship channel near Pasadena. The plant will be called "Port Adams" in honor of the Phillips president.

Consulting Group Formed

Dr. Norris Johnston and F. H. Bailly, Pasadena, have organized a combined engineering and laboratory service for the producing branch of the oil industry. One branch, Oil Properties Consultants Inc., offers complete reservoir engineering service, while the other, Petroleum Engineering Associates Inc., gives reservoir laboratory service.



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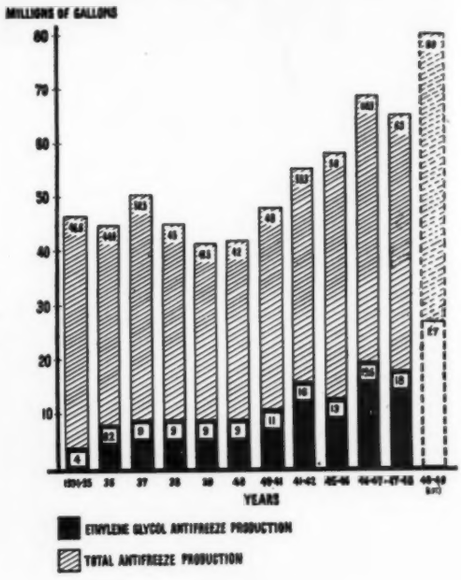


Texaco Markets Ethylene Glycol

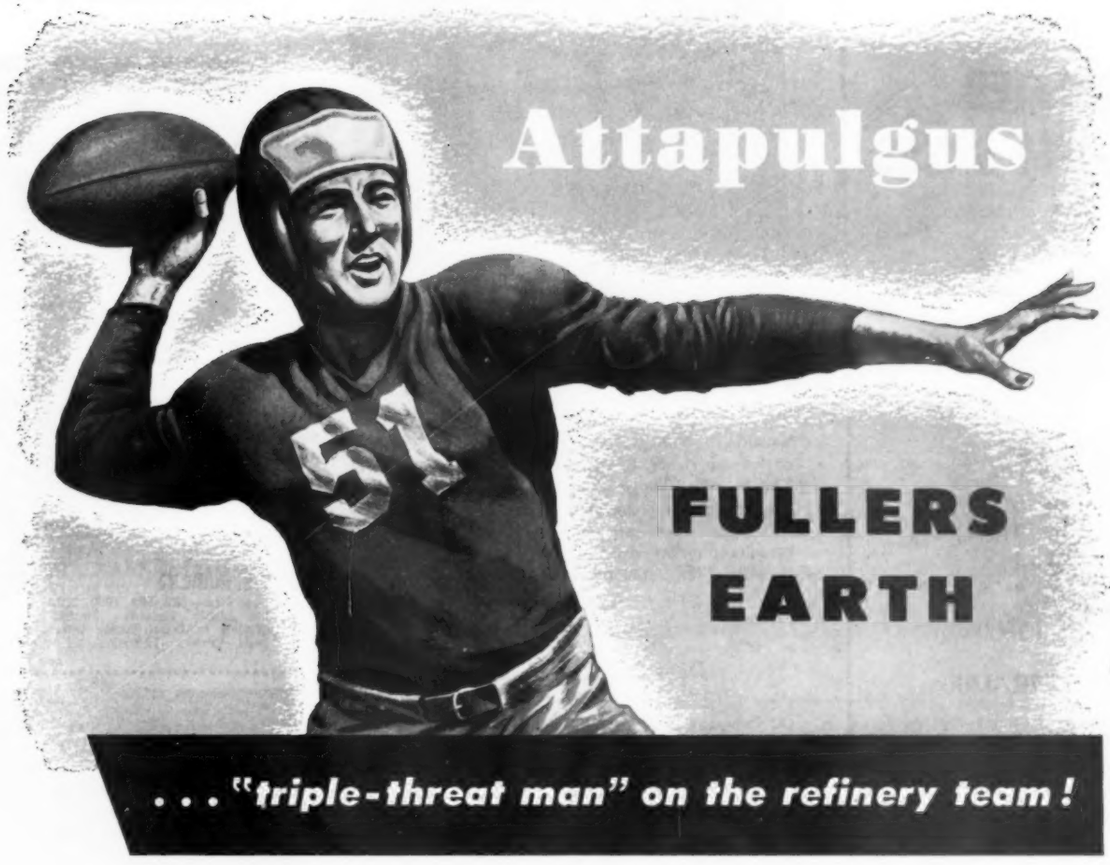
Ethylene glycol production of Jefferson Chemical Company's new plant at Port Neches, Texas, will be marketed by The Texas Company during the coming winter. The recently completed plant is jointly owned by Texaco and American Cyanamid Co. Hydrocarbon gases from the huge Port Arthur refinery of The Texas Co. are processed.

Walter Hochuli, general sales manager for The Texas Co., estimates that ethylene glycol permanent type antifreeze production during the coming winter season will approximate 27 million gallons, an increase of 50 percent over 1947-48. Total antifreeze sales will be about 80 million gallons compared with 65 millions a year ago.

Robert B. Cragin

R. B. Cragin to Refinery Maintenance

Robert B. Cragin has been elected a vice president of Refinery Maintenance Co., Inc., Compton, California, and Houston, Texas. Mr. Cragin served as a vice president of Houdry Process Corp. from 1944 until his resignation in March of this year. Prior to this he served as assistant director of the refining division, PAW, in Washington during the war years. He is a graduate of Princeton University and was employed by The M. W. Kellogg Company as process and sales engineer from the time of his graduation until his government services.



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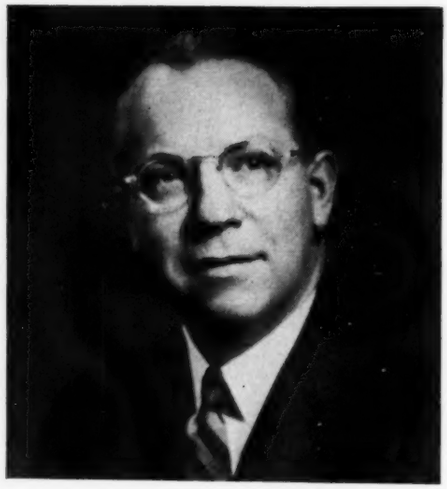

Ronald B. Smith

Ronald B. Smith Joins Kellogg

Ronald B. Smith, engineering expert of long and varied experience, has joined the engineering staff of The M. W. Kellogg Co. His special fields include gas turbines, superchargers, condensers, oxygen plants and power machinery in general. Mr. Smith is a consultant to the Atomic Energy Commission and a member of the National Advisory Committee for Aeronautics as well as the author of numerous technical papers.

Death of P. J. Gallagher

Peter J. Gallagher, an executive of Standard-Vacuum Oil Company until his retirement in January last after 35 years of service, died at his home in Sequim, Wash., on September 30. Prior to his retirement he resided in New Rochelle, N. Y.

Mr. Gallagher was born in Ithaca, N. Y., and graduated from Cornell University in 1911. He entered the oil company's employ directly afterward and was sent to China in 1912. After service in the U. S. Navy during World War I, he was made manager of the company's South China division and was in charge of outside product purchases for the entire Far East. He returned to New York in 1940 as manager of the oil fuels department, a position he retained until his retirement. He was a member of the Cornell Club of New York and the Wykagyl Club of New Rochelle.

Heads New Regional Office

B. F. Bilsland has been promoted from manager of the Allis-Chalmers Chicago district to manager of the company's newly-formed Midwest region. He has been with Allis-Chalmers since 1919 and has been manager of the Chicago district for the last 15 years. He will continue to make his headquarters in Chicago. J. C. Collier, who has been employed by Allis-Chalmers since 1916, succeeds Mr. Bilsland as Chicago district manager.

Kobe Inc. Names Vice Presidents

Increased activities of Kobe Inc. have led to the enlargement of its executive department by the election of H. K. Browning and L. T. Wold as vice presidents. Mr. Browning has been with the company since 1940. For the past six years he has been general sales manager and directed the highly successful "Free Pump" campaign which the company inaugurated last year. He will now serve as assistant general manager. Mr. Wold came to the West Coast in 1946 as controller of the company after several years as auditor for American Steel and Wire Company. In his new position he will be in charge of operation and finance.

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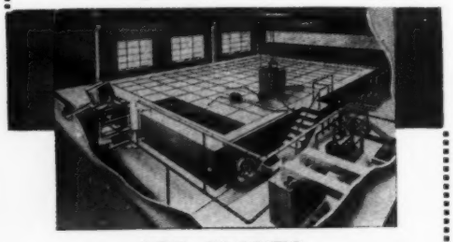

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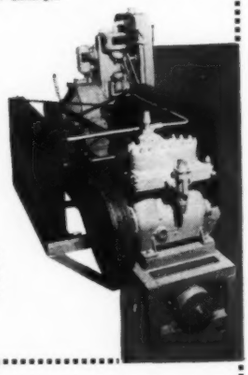

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Bibliographic Survey of Corrosion

Bibliographic Survey of Corrosion—1945, by Robert D. Misch, James T. Waber and Hugh J. McDonald, all of The Corrosion Research Laboratory, Illinois Institute of Technology, Chicago, Ill. Published by the National Association of Corrosion Engineers, 905 Southern Standard Building, Houston 2, Texas. 129 pages, 8½ x 11 inches, cloth binding, $5.00 per copy.

This book contains approximately 1100 references to published articles relating to corrosion and 170 references to patents that appeared from January, 1945 to February, 1946. The abstracts are divided into two classes, general material and patents. Each class is divided into nine main groups.

Todd Ranch Gasoline Plant

Continental Oil Company will operate a natural gasoline plant which is to be erected in the Todd Ranch field, west Texas. The plant will handle all of the gas produced at the field and will have a capacity of 10 million cubic feet daily. It will recover approximately 60,000 gallons of liquid hydrocarbons per day. Refinery Maintenance Company of Compton, California, has been named contractor, and completion of the plant is expected within 12 months.

There are 23 participating operators in the field which was discovered in April 1940. The field consists of the Ellenburger pool, in which there are 58 wells producing from approximately 6,100 feet, and of the Crinoidal pool, in which there are 30 wells producing from approximately 5,600 feet. Twenty-three wells in the Ellenburger pool and 16 wells in the Crinoidal pool are operated by Continental Oil Co.

Refinery Training Films

The American Petroleum Institute's division of refining has cataloged all available films suitable for training in refining operations. The 200-page volume is entitled "A Catalogue of Films Applicable to Training in Refining." Orders should be placed with the American Petroleum Institute, 50 West 50th Street, New York 20, N. Y. The price is $3.

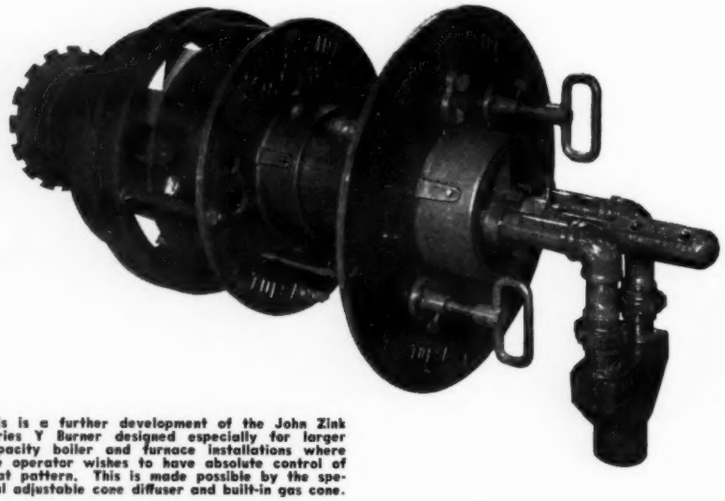
Cooper-Bessemer Opens Chicago Office

Expansion of the Cooper-Bessemer Corporation's nationwide sales facilities, through the addition of a Chicago branch office, is announced by Stanley E. Johnson, vice president and director of sales. The new office, located at 122 South Michigan Avenue, in the People's Gas Building, will be under the direction of Robert S. Bowie. Mr. Bowie joined Cooper-Bessemer as a member of its headquarters sales staff in Mount Vernon, Ohio, in 1936 and subsequently was

Charles L. White

in the Dallas sales office. He has been active in the Chicago area since 1946. Mr. Bowie's activities will continue under the supervision of Charles L. White, district manager for Cooper-Bessemer in the North Central area. Mr. White's headquarters are in the company's Mount Vernon offices.

The New JOHN ZINK "YC" COMBINATION OIL & GAS BURNER



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Aboard one-third of the world's merchant ships, hundreds of railroads, thousands of planes, trucks, busses...

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SOCONY-VACUUM

Frank Champion

R. E. Smith

Form Export Company

Two men widely known to the oil industry have joined forces in the formation of an export organization to serve American manufacturers in the export field. Their company is Champion & Smith, Inc., with offices in Los Angeles, Houston and New York. Frank Champion, of Houston, is president and Roland E. Smith is secretary-treasurer. Mr. Champion formerly was a vice president of Byron-Jackson Co. and general manager of its oil tool division. More recently he has been head of the Champion Oil & Gas Co. of Houston. Mr. Smith has had wide experience in the equipment and supply business as a former member of the export division of Byron-Jackson and sales manager for Grant Oil Tools. For the past five years he has traveled extensively abroad as an independent export representative. Both men have been prominent in the Nomads organization, Mr. Champion being a charter member of the first chapter to be organized and being a past president of the Houston chapter. Mr. Smith was president of the Los Angeles chapter in 1944.

Latin American representative of the company is R. B. "Bob" Block who has spent twenty years in that field, having served as drilling superintendent for the International Petroleum Company in Peru, with later experience in Ecuador, Colombia and other Latin American countries.

Wins Annual Report "Oscar"

A. J. Smith, president of Black, Sivalls & Bryson, Kansas City, Mo., accepted the bronze "Oscar of Industry" at a dinner at New York on Oct. 21 sponsored by the Financial World. The "Oscar" was in recognition of the selection of the BS&B annual report for 1947 as the best out of some 4,000 judge by a jury of experts. It was the second consecuti year that the company won the award.

Ultramar Output Below Expectations

Output from Ultramar, Venezuela, oil fields has fallen below expectations, according to a circular which has been issued to shareholders in London. Production from the Mercedes and Palacio fields is given as an average of 11,257 barrels daily as against an anticipated 25,000 barrels daily, due to unforeseen characteristics of the reservoir sands and to unsatisfactory completions of some of the wells. It is estimated now that after the completion of further wells on those portions of the Mercedes and Palacio fields now being developed, production will reach 15,000 barrels a day early in 1949.

Owing to the unexpected low initial production, Caracas Petroleum S. A. must provide S. A. P. Las Mercedes with additional funds estimated to amount to approximately $3,500,000 to meet the balance of its capital commitments and development expenditure to June 30, 1949. Some increase in this requirement may be decided upon, should it be deemed advisable to develop new areas more rapidly. Meanwhile, The Texas Company has to date provided finance to meet the immediate requirements of S. A. P. Las Mercedes by means of advance payments for oil.

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FOR OIL REFINERIES

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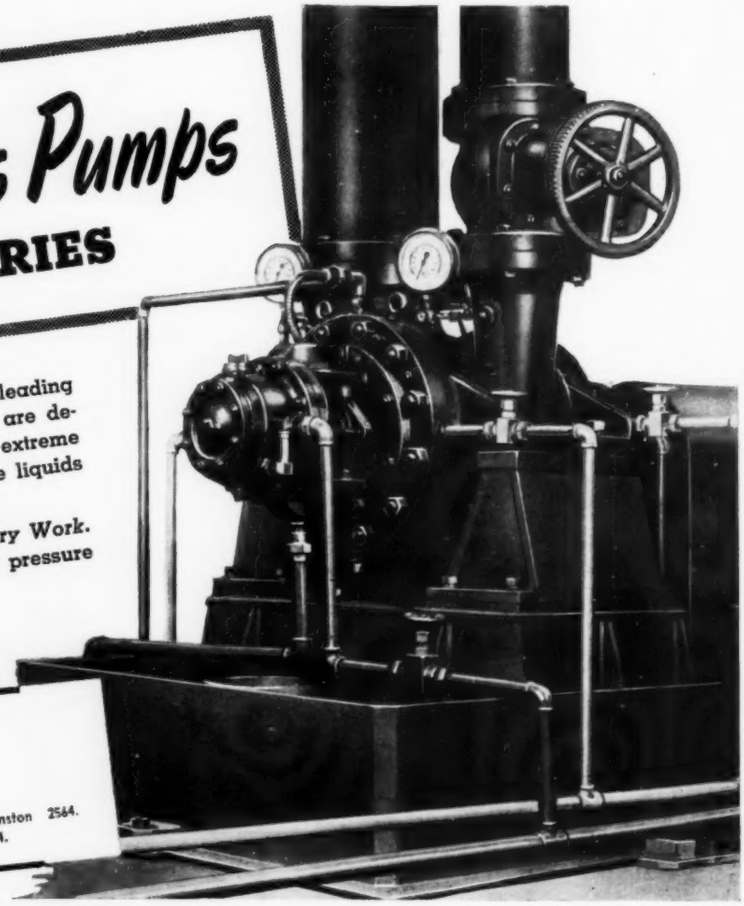
MATERIAL 18/18/3 Stainless Steel.



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